

1) A 46-year-old woman with a multisystem disorder presents with dysphagia and heartburn. Barium swallow reveals a dilated oesophagus with aperistalsis of the lower two-thirds of the oesophagus, a patulous lower oesophageal sphincter and gastro-oesophageal reflux. Which other organ system is most likely to be affected?

- a. respiratory
- b. cardiovascular
- c. skin
- d. central nervous
- e. renal

1) c. \*\*\*

The patient is suffering from systemic sclerosis, a multisystem connective tissue disorder of unknown aetiology, classified by extent of skin involvement and overlap with other autoimmune disorders. The skin is the most commonly involved organ, demonstrating thickening, atrophic changes and fibrosis. The gastrointestinal system is the next most commonly affected, with around 50% of patients having symptomatic disease. The oesophagus is most frequently involved, with fibrosis of the circular layer of smooth muscle resulting in a dilated oesophagus with absent or reduced peristalsis in the lower two-thirds. The lower oesophageal sphincter is wide, in contrast to the tapered narrowing seen in achalasia. Patients suffer from reflux that predisposes to Barrett's oesophagus and distal strictures. The cardiovascular, respiratory, central nervous and renal systems may all be affected in systemic sclerosis, though less commonly than the skin and gastrointestinal systems.

- 3) A 65-year-old man undergoes endoscopy for dysphagia, during which an ulcerated mass is seen in the distal oesophagus. Biopsy confirms oesophageal adenocarcinoma. What is the most accurate imaging modality for local staging of oesophageal cancer?
- a. endoscopic ultrasound
  - b. CT
  - c.  $^{18}\text{F}$ FDG PET/CT
  - d. MRI
  - e. barium swallow

3) a. \*\*\*

CT is the most commonly used imaging investigation for staging of oesophageal cancer. However, the overall accuracy of T staging is poor, particularly with T1 and T2 tumours, and CT also tends to overestimate tumour length. Endoscopic ultrasound scan is the most accurate imaging method for local staging, but is limited in its assessment of nodal and metastatic disease.  $^{18}\text{F}$ FDG PET/CT is useful in evaluation of nodal and metastatic disease, particularly in patients being considered for surgical resection, but has limited resolution for T staging and often fails to demonstrate T1 lesions. MR is useful in characterization of

indeterminate liver lesions seen on CT. Barium swallow is not used in the staging of oesophageal cancer.



19) A 70-year-old man with a history of several months of dysphagia undergoes double-contrast barium swallow. This demonstrates a moderately dilated oesophagus with reduced peristalsis and smooth tapering of the distal oesophagus. What is the most likely diagnosis?

- a. primary achalasia
- b. gastric carcinoma
- c. scleroderma
- d. oesophageal carcinoma
- e. presbyoesophagus

19) b. \*\*\*\*

**Primary achalasia** is an abnormality of the myenteric plexus resulting in reduced or absent peristalsis and failure of relaxation of the lower oesophageal sphincter. The oesophagus is typically markedly dilated with absent primary peristalsis and a smooth tapered narrowing at the contracted lower oesophageal sphincter. It usually presents in young adults with long-standing dysphagia. In contrast, **secondary achalasia** due to malignancy usually presents in older patients with a short duration of dysphagia. Decreased peristalsis and distal oesophageal tapering in these patients result from tumour infiltration of the myenteric plexus of the distal oesophagus by gastric carcinoma, lymphoma or metastatic disease. **Distal oesophageal carcinoma** tends to give rise to irregular, asymmetrical narrowing. **Scleroderma** typically appears as a dilated oesophagus with a patulous lower oesophageal sphincter.

**Presbyoesophagus** is a disorder of oesophageal motility, characterized by oesophageal dilatation and repetitive, non-peristaltic, tertiary contractions in the distal oesophagus.

22) A 23-year-old man with dysphagia undergoes a double-contrast barium swallow, which demonstrates a smooth, well-defined, 12 cm submucosal lesion in the distal oesophagus causing deformity of the lumen. CT demonstrates coarse calcification within the mass. What is the most likely diagnosis?

- a. oesophageal lipoma
- b. oesophageal duplication cyst
- c. oesophageal carcinoma
- d. oesophageal varices
- e. oesophageal leiomyoma

22) e. \*\*\*

**Leiomyomas** are benign tumours of smooth muscle, and represent the most common benign neoplasm of the oesophagus. They are often asymptomatic but may present with dysphagia and rarely haematemesis. They appear on barium swallow as large, well-defined, intramural masses causing luminal deformity. A characteristic finding is of coarse calcifications – leiomyoma is the only calcifying oesophageal tumour. **Oesophageal lipomas** and **duplication cysts** also appear as well-defined submucosal lesions (of fat and of water density respectively on CT), but are less common, and internal calcification is not a feature. **Oesophageal carcinoma** usually appears as an irregular ulcerated stricture. **Oesophageal varices** are seen as serpiginous filling defects.

24) A 56-year-old man presents acutely with chest pain after a night out. On examination he is febrile, tachycardic and hypotensive. Chest radiograph demonstrates extensive pneumomediastinum, with left pleural effusion and left lower lobe atelectasis. What is the most likely diagnosis?

- a. acute pulmonary embolism
- b. spontaneous oesophageal rupture
- c. aortic dissection
- d. lobar pneumonia
- e. acute pancreatitis



24) b. \*\*

Iatrogenic injury is the most common cause of oesophageal rupture, but, in 15% of cases, rupture is spontaneous and occurs during vomiting (Boerhaave's syndrome). Patients present with pain and dysphagia, and rapidly develop sepsis. Characteristic chest radiograph findings are of extensive pneumomediastinum and subcutaneous emphysema, pleural effusion or hydropneumothorax, and left lower lobe atelectasis.

Widening of the mediastinum may accompany the development of mediastinitis. Pleural effusion and atelectasis may be seen in acute pulmonary embolism, acute pancreatitis and aortic dissection, but pneumomediastinum is not a recognized feature of these conditions.

Other common causes of pneumomediastinum include asthma; chest trauma and perforation of a hollow viscus with extension of gas via the retroperitoneum.

34) A 26-year-old man known to have AIDS presents with a 2-week history of difficult and painful swallowing. He undergoes double-contrast barium examination of the oesophagus, which demonstrates multiple, small, superficial, round ulcers in the mid-oesophagus. The intervening mucosa is normal and no plaques are seen. What is the most likely diagnosis?

- a. HIV oesophagitis
- b. cytomegalovirus oesophagitis
- c. reflux oesophagitis
- d. candida oesophagitis
- e. herpes simplex oesophagitis

34) e. \*\*\*\*\*

*Candida oesophagitis* is the commonest cause of infectious oesophagitis and is particularly seen in immunosuppressed individuals. It is frequently associated with oral thrush. It tends to affect the upper half of the oesophagus, and typical appearances are of linear, longitudinally oriented filling defects representing heaped-up areas of mucosal plaques consisting of necrotic debris and fungal colonies. In contrast, a normal intervening mucosa in oesophagitis is suggestive of a viral aetiology. Findings in cytomegalovirus and HIV oesophagitis are similar, with typical appearances of one or more large flat ulcers seen in the distal oesophagus. Distinction between the two is made by brushings or biopsy at endoscopy. In herpes simplex infection, the typical features of multiple, small, superficial ulcers are similar at all sites of potential involvement, including the oesophagus, oral cavity, rectum and anus.

37) A 45-year-old man presents with dysphagia and undergoes a double-contrast barium swallow. This demonstrates a smooth oblique indentation on the posterior wall of the oesophagus. What is the most likely cause of these appearances?

- a. enlarged left atrium
- b. aberrant right subclavian artery
- c. aberrant left pulmonary artery
- d. right-sided aortic arch
- e. coarctation of the aorta



37) b. \*\*\*

A number of anomalies of the major vessels can cause extrinsic impressions upon the oesophagus. The commonest aortic anomaly is a right-sided aortic arch, which produces an indentation on the right lateral oesophageal wall in the absence of the normal left aortic arch impression. An aberrant right subclavian artery originates from the aortic arch just distal to the left subclavian artery, and passes upwards and to the right, behind the oesophagus, giving rise to an oblique posterior oesophageal indentation. In aortic coarctation, the pre- and post-stenotic dilatations of the aorta produce a characteristic reversed-3 impression upon the left wall of the oesophagus. An enlarged left atrium and an aberrant left pulmonary artery both cause anterior indentations upon the oesophagus.

51) A 45-year-old man undergoes barium swallow for dysphagia, which demonstrates multiple flask-shaped outpouchings of barium arranged in longitudinal rows paralleling the long axis of the oesophagus. Which of the following is a commonly associated condition?

- a. scleroderma
- b. rheumatoid arthritis
- c. chronic obstructive airway disease
- d. AIDS
- e. diabetes

51) e. \*\*\*

Oesophageal intramural pseudodiverticulosis is a condition causing dilatation of the ducts of the submucosal glands of the oesophagus. These appear on barium meal as multiple, tiny, flask-shaped collections of barium arranged in longitudinal rows. They may appear to 'float' outside the oesophagus, as the connection to the lumen may not be appreciated. Associated strictures in the distal oesophagus are common. The condition is commonly associated with diabetes and chronic alcoholism, but may also occur with severe oesophagitis of any cause. *Candida* may be cultured in around half the cases, but this may be a secondary infection due to stasis of secretions within the glands.

52) What is the most common cause of varices affecting the upper third of the oesophagus?

- a. portal hypertension due to cirrhosis
- b. splenic vein thrombosis
- c. inferior vena caval obstruction
- d. superior vena caval obstruction
- e. hepatic vein obstruction

52) d. \*\*\*\*

Oesophageal varices are dilated submucosal veins, which may be classified by their direction of flow as uphill or downhill varices. Uphill varices occur in the lower oesophagus and represent collateral blood flow conveying portal venous blood to the azygos vein. They usually result from portal hypertension due to liver cirrhosis, but may also occur with splenic vein thrombosis, and obstruction of the hepatic veins or IVC. Downhill varices result from obstruction of the SVC. If it is obstructed superior to the entry of the azygos vein, varices will be confined to the upper third of the oesophagus. If the SVC is obstructed below the entry of the azygos vein, the varices convey all of the systemic venous blood from the upper half of the body into the portal vein and IVC, and they will run the entire length of the oesophagus. SVC obstruction is most commonly due to lung cancer or lymphoma.



- 61) A 76-year-old woman presents with dysphagia and regurgitation of undigested food. She undergoes barium swallow, which demonstrates a barium-filled pouch extending from the posterior oesophageal wall at the level of C5–6 that is causing oesophageal compression. What is the most likely diagnosis?
- a. intramural pseudodiverticulum
  - b. epiphrenic diverticulum
  - c. lateral pharyngeal diverticulum
  - d. interbronchial diverticulum
  - e. Zenker's diverticulum

61) e. \*\*\*

A **Zenker diverticulum** is a herniation of the mucosa and submucosa through the midline of the posterior oesophageal wall at the cleavage plane between the oblique and transverse fibres of cricopharyngeus (Killian's dehiscence) at the level of C5–6. The diverticulum is narrow necked and extends caudally, resulting in trapping of undigested food and compression of the adjacent oesophagus. **Epiphrenic diverticula** are rare, usually occurring on the right lateral wall of the distal oesophagus in association with hiatus hernia. **Lateral pharyngeal diverticula** are herniations of pharyngeal mucosa through the lateral pharyngeal wall, which occur most commonly in wind instrument players, reflecting increased intrapharyngeal pressure. An **interbronchial diverticulum** is a traction diverticulum that occurs in the interbronchial segment of the oesophagus in response to adjacent fibrous adhesions following lymph-node infection (usually tuberculous). **Intramural pseudodiverticula** represent dilated excretory ducts of mucosal glands, which appear as multiple flask-shaped outpouchings and are commonly seen in association with candidiasis.

- 62) A 68-year-old man undergoes barium swallow for dysphagia. During the examination the patient has an episode of coughing, and barium is noted to enter the larynx and proximal trachea. What is the appropriate management?
- a. no action needed
  - b. physiotherapy
  - c. prophylactic antibiotics
  - d. chest radiograph in 48 hours
  - e. admission to hospital for observation

62) b. \*\*\*

Barium aspiration is a recognized complication of barium swallow, and may occur particularly in patients with swallowing disorders or recent oesophageal surgery. It is usually clinically insignificant, but complications have been reported, especially with aspiration of larger amounts of barium, and include pneumonitis and granuloma formation. Physiotherapy is the only treatment recommended. Of the water-soluble contrast agents, Gastrografin (ionic and hyperosmolar) may cause pulmonary oedema if aspirated. Gastromiro (non-ionic and iso-osmolar) is safe to use if aspiration is a significant possibility.

- 71) Which structure marks the transition from squamous oesophageal to columnar gastric epithelium?
- a. A-ring
  - b. B-ring
  - c. Z-line
  - d. oesophageal vestibule
  - e. gastro-oesophageal junction



71) c. \*\*\*\*

The transition from squamous oesophageal epithelium to columnar gastric epithelium is marked by the Z-line, an irregular zigzag line. It is not a reliable indicator of the gastro-oesophageal junction, however, and may lie some distance above it if there is columnar transformation of the distal oesophagus, as seen in Barrett's oesophagus. The gastro-oesophageal junction may be identified by a thin, shelf-like ring known as the B-ring. It is visible on barium swallow only when the gastro-oesophageal junction lies above the diaphragmatic hiatus.

Approximately 2–4 cm above this is a thicker ring produced by active muscle contraction known as the A-ring. The oesophageal vestibule is the saccular termination of the lower oesophagus, which lies between the A-ring and the B-ring, and corresponds with the lower oesophageal sphincter.

*Schatzki ring = narrowed esophageal lumen through B-ring due to reflux disease*

Z-line is an endoscopic landmark.

94) At endoscopic ultrasound scan for staging of an oesophageal carcinoma, the tumour is seen extending into the hypoechoic fourth layer of the oesophagus but not beyond this. What is the T staging of the tumour?

- a. Tis
- b. T1
- c. T2
- d. T3
- e. T4

94) c. \*\*\*\*

Endoscopic ultrasound is the most accurate method for local staging of oesophageal cancer. At endoscopic ultrasound, the oesophageal wall appears as five distinct alternating hyperechoic and hypoechoic bands that correspond to the histological layers of the oesophagus. The innermost hyperechoic layer represents the interface between the lumen and the mucosa. The hypoechoic second layer is a hypoechoic band that represents the muscularis mucosa. The third layer is a hyperechoic band that represents the submucosa. The fourth layer is a hypoechoic band that represents the muscularis propria. The fifth outermost layer is a hyperechoic band that represents the oesophageal adventitia. The fifth layer in the stomach, duodenum and rectum represents the serosa. For oesophageal cancer, T1 tumours invade the lamina propria or submucosa. T2 tumours invade the muscularis propria, T3 tumours invade the adventitia and T4 tumours invade adjacent tissue. Tis represents carcinoma *in situ*.

- 97) A 47-year-old woman with dysphagia undergoes barium swallow, which demonstrates a persistent smooth posterior bulge at the pharyngo-oesophageal junction at the level of C5-6 with mild proximal pharyngeal dilatation. What is the most likely diagnosis?
- a. normal findings
  - b. impaired cricopharyngeus relaxation
  - c. pharyngeal web
  - d. anterior cervical osteophytes
  - e. thyroid enlargement

97) b. \*\*\*

Impaired cricopharyngeus relaxation (or cricopharyngeal achalasia) is hypertrophy of the cricopharyngeus muscle with failure of relaxation. It is seen in up to 10% of asymptomatic adults as a normal variant, as a compensatory mechanism in gastro-oesophageal reflux, and in association with a range of neuromuscular disorders. It appears on barium swallow as a smooth, shelf-like posterior projection at the level of C5–6 that persists during a swallow. In severe cases, it may result in functional obstruction or overflow aspiration. Symptomatic patients may be treated by cricopharyngeal myotomy. Pharyngeal webs are thin, anterior, shelf-like protrusions into the cervical oesophagus. They are frequent incidental findings but occasionally cause dysphagia. There is an association with Plummer–Vinson syndrome. Anterior osteophytes may cause an indentation of the posterior oesophagus, but these are usually asymptomatic. Thyroid enlargement may cause a smooth impression on the lateral wall of the oesophagus.

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1. A 71 year old female with scleroderma undergoes a barium swallow examination. Which one of the following findings concerning the oesophagus would not be consistent with this diagnosis?
- a. Oesophageal dilatation
  - b. Superficial ulcers
  - c. Hypoperistalsis in the upper third of the oesophagus
  - d. Stricture 5 cm above the gastro-oesophageal junction
  - e. Oesophageal shortening

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1. c. Hypoperistalsis in the upper third of the oesophagus

The oesophagus is the most commonly involved location of the gastro-intestinal tract in patients with scleroderma. Smooth muscle atrophy causes hypoperistalsis and eventually aperistalsis in the lower two-thirds of the oesophagus. The upper third of the oesophageal wall contains skeletal muscle and is therefore unaffected by the disease process.



3. A neonate is diagnosed with congenital tracheoesophageal (TE) fistula. A plain film demonstrates a gasless abdomen. Which type of TE fistula is associated with this finding?

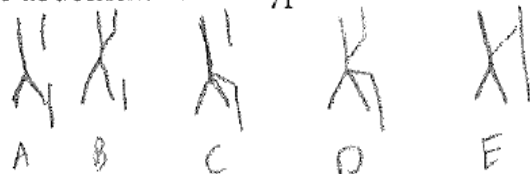
a. Type B

b. Type C

c. Type D

d. Type E

e. None of the above



3. a. Type B

Congenital TE fistula and oesophageal atresia occur in approximately 1 in 4000 live births. They are divided into five subtypes, A to E. Type C is the most common, comprising 75% of all types and involves oesophageal atresia with a distal TE fistula. Type D involves oesophageal atresia with both proximal and distal TE fistula, and type E is a TE fistula without oesophageal atresia. Therefore types C to E do not typically present with gasless abdomen. Type B is oesophageal atresia with a proximal TE fistula; there is no communication between the trachea and the distal oesophagus, and therefore a gasless abdomen is typical. Type A is oesophageal atresia without TE fistula and therefore may also present with a gasless abdomen, but is not a listed option.

10. A 32 year old male is referred for a barium swallow by his GP due to dysphagia resistant to medical treatment. A smooth, lobulated, eccentric mass is seen in the middle third of the oesophagus containing foci of calcification. The diagnosis is most likely to be which one of the following?

a. Leiomyoma

b. Squamous cell carcinoma

c. Adenocarcinoma

d. Oesophageal web

e. Intramural pseudodiverticulosis



10. a. **Leiomyoma**

Oesophageal leiomyoma is the most common benign submucosal tumour of the oesophagus, typically occurring in young men. The classical features of oesophageal leiomyoma include a smooth intramural mass in the lower or middle third of the oesophagus with intact overlying mucosa. It is the only tumour of the oesophagus that calcifies, although calcification is rare.

12. A 67 year old man is referred for a barium swallow from the surgical outpatient department with a history of dysphagia to solids. A mid-oesophageal stricture is demonstrated. Which one of the following causes is unlikely to be in the differential?
- a. Barrett's oesophagus
  - b. Squamous cell carcinoma of the oesophagus
  - c. Schatzki ring
  - d. Caustic substance ingestion
  - e. Epidermolysis bullosa

12. c. **Schatzki ring**

All are reasonable differentials for a mid-oesophageal stricture, albeit with varying degrees of frequency, with the exception of a Schatzki ring which is found in the lower oesophagus. It occurs near the squamocolumnar junction and is associated with reflux. It is non-distensible and best seen in the prone position on barium swallow examinations. Schatzki rings are often asymptomatic, but oesophageal dilatation may be required where dysphagia is severe.

50. A 51 year old male patient has a barium swallow for the investigation of dysphagia. This shows a 10 cm tapered stricture in the mid oesophagus along with multiple fine linear projections perpendicular to the lumen, each 3–4 mm long, in this segment. There are occasional tertiary contractions and mild gastro-oesophageal reflux. What is the most likely diagnosis?
- Chagas disease
  - Oesophageal intramural pseudodiverticulosis
  - Oesophageal varices
  - Cytomegalovirus* infection
  - Oesophageal carcinoma

**50. b. Oesophageal intramural pseudodiverticulosis**

Oesophageal intramural diverticulosis relates to dilated excretory ducts of the deep mucous glands of the oesophagus. They are best demonstrated on barium swallow and have the classical appearance as described in the question. The pseudodiverticular can appear to float outside the oesophagus when no communication with the lumen is seen. Most patients have dysphagia at presentation and associated conditions include diabetes, candida infection, oesophagitis, stricture and alcohol abuse.

- 1 A 54-year-old female presented with dysphagia and an endoscopy was unsuccessful due to a pharyngeal pouch, hence a barium swallow was performed. This showed a mass-like filling defect in the mid third of the oesophagus. A CT showed a focal oesophageal wall mass and histology was obtained, which was consistent with metastatic disease from a distant primary. What is the most likely site of the primary?
- Breast
  - Colon
  - Hepatic
  - Ovarian
  - Pancreas

1 Answer A: Breast

The most common direct extension to the oesophagus is from the bronchus. The most common metastases from a distant primary are from breast, which are usually submucosal.

- 2 A middle-aged woman presented with reflux and underwent a barium swallow. There was an incidental finding in the cervical oesophagus near the cricopharyngeus where a thin membrane of uniform thickness (2 mm) extending from the anterior oesophageal wall was visible. Her past medical history includes treated hypothyroidism and investigations for iron deficiency anaemia. What is the most likely diagnosis?
- a Complications related to hypothyroidism
  - b Epidermolysis
  - c Oesophageal stricture
  - d Plummer-Vinson syndrome
  - e Schatzki ring

2 Answer D: Plummer-Vinson syndrome

Plummer-Vinson syndrome is characterised by oesophageal webs, iron deficiency anaemia, stomatitis, glossitis, dysphagia, thyroid disorders and spoon-shaped nails. An oesophageal web is usually seen near the cricopharyngeus and arises at right angles from the anterior oesophageal wall. It is usually asymptomatic unless there is severe stenosis.

- 5 An immunocompromised patient with HIV presented acutely with odynophagia. Particularly severe substernal chest pain occurred during swallowing. A double contrast barium swallow was performed which showed multiple small (<1 cm) superficial ulcers in the upper and mid oesophagus without plaque formation. These ulcers had a punctate configuration and were surrounded by radiolucent mounds of oedema. On the basis of the radiological findings what is the most likely diagnosis?
- a *Candida* oesophagitis
  - b CMV oesophagitis
  - c Herpes oesophagitis
  - d HIV oesophagitis
  - e Tuberculous oesophagitis

5 Answer C: Herpes oesophagitis

- 6 A 32-year-old female was investigated for severe odynophagia with a barium swallow which reproduced the patient's symptoms. The findings were recorded as 'compartmentalisation of the oesophagus with numerous tertiary contractions'. Very high pressures were noted on manometry studies. What is the most likely diagnosis?
- a Achalasia
  - b Chhalasia
  - c Diffuse oesophageal spasm
  - d Presbyesophagus
  - e Plummer-Vinson syndrome

6 Answer C: Diffuse oesophageal spasm

The classic presentation of diffuse oesophageal spasm is with severe intermittent pain while swallowing. These swallow appearances are characteristic and extremely high pressures are seen on manometry.

- 7 A patient presented with dysphagia initially to liquids then also gradually to solids. A barium swallow demonstrated a stricture of the distal oesophagus and a subsequent biopsy confirmed malignancy. What cell type would be most likely?
- a Lymphoma
  - b Metastases
  - c Squamous cell carcinoma
  - d Leiomyosarcoma
  - e Adenocarcinoma

7 Answer C: Squamous cell carcinoma

Squamous cell carcinoma in 95%, associated with head and neck carcinoma, smoking, alcohol, achalasia and Lye ingestion. Adenocarcinoma (5%) usually occurs in the lower oesophagus at the GOJ and is associated with Barrett's oesophagus. It is increasing in frequency.



- 8 A 46-year-old female underwent a barium swallow to investigate dysphagia. An indentation was seen on the posterior aspect of the mid thoracic oesophagus. What is the most likely explanation?
- a Aberrant left subclavian artery
  - b Aberrant right subclavian artery
  - c Normal aortic indentation
  - d Oesophageal web
  - e Impression of the cricopharyngeus

8 Answer B: Aberrant right subclavian artery

The right subclavian artery normally arises from the brachiocephalic trunk bifurcation. An aberrant right subclavian is the last branch of the aortic arch distal to the left subclavian and indents the oesophagus posteriorly.

- 9 A 62-year-old woman presented with dysphagia. She was otherwise well but was known to have long-standing diabetes. A barium swallow was performed which showed multiple tiny collections of barium adjacent to the oesophageal lumen. A short distal oesophageal stricture was also noted. With what diagnosis are these radiological findings most consistent?
- a Adenomyomatosis
  - b Erosive oesophagitis
  - c Oesophageal intramural pseudodiverticulosis
  - d Pharyngeal pouch
  - e True oesophageal diverticulum

9 Answer C: Oesophageal intramural pseudodiverticulosis

The characteristic features of oesophageal intramural pseudodiverticulosis on barium swallow include multiple tiny 'floating' barium collections and oesophageal structuring. In 90% of cases it is associated with diabetes, alcoholism, oesophagitis and structuring.

- 10 A 21-year-old woman with a long history of recurrent episodes of aspiration pneumonia was noted to have a fluid level within the mediastinum on her chest radiograph. A barium swallow was then performed which showed absence of primary peristalsis and evidence of non-peristaltic contractions. What is the most likely diagnosis?
- a Chagas disease
  - b Peptic stricture
  - c Primary achalasia
  - d Scleroderma
  - e Secondary achalasia

10 Answer C: Primary achalasia

Primary achalasia is characterised by failure of organised peristalsis and relaxation of the lower oesophageal sphincter. Imaging features include: megaoesophagus, absent primary peristalsis, nonperistaltic contractions and 'rat-tail'/'bird-beak' oesophagus.

- 11 A patient presented to the Emergency Department with epigastric and retrosternal pain. A significant oesophageal injury was suspected clinically. Which of the following clinical, radiological or surgical findings are more suggestive of Boerhaave's syndrome than a Mallory-Weiss tear?
- a Distal oesophageal injury
  - b Haematemesis
  - c History of alcoholism
  - d Oesophageal mucosal irregularity
  - e Pneumomediastinum

11 Answer E: Pneumomediastinum

Spontaneous oesophageal perforation (Boerhaave's syndrome) typically results from persistent vomiting following an alcoholic binge. Radiographic features typically include: pneumomediastinum, pleural effusion and mediastinal haematoma.

- 1 A 53-year-old gentleman was investigated for mild dysphagia. He was found to have an area of focal wall thickening at the junction of the mid and distal thirds of the oesophagus, which was shown to be squamous cell carcinoma on biopsy. After further assessment there was no evidence of distant disease and depending on local staging the patient could be a candidate for aggressive surgery. What would be the modality of choice for accurate local staging?
- a Dual-phase contrast-enhanced CT of chest, abdomen and pelvis
  - b Endoscopic ultrasound
  - c MRI
  - d PET-CT
  - e Triple-phase contrast-enhanced CT of chest, abdomen and pelvis

1 Answer B: Endoscopic ultrasound

Endoscopic ultrasound can identify the five separate layers of the oesophageal wall.

- 2 A 55-year-old male with a history of drug and alcohol abuse underwent an elective barium swallow for follow-up after surgery for laryngeal carcinoma. This demonstrated tortuous longitudinal filling defects in the lower third of a partially collapsed oesophagus. What is the most likely cause of these radiological findings?
- a Achalasia
  - b Mucosal oedema associated with oesophagitis
  - c Oesophageal lymphoma
  - d Oesophageal varices
  - e Varicoid oesophageal carcinoma

2 Answer D: Oesophageal varices



- 5 A patient with Parkinson's disease had an elective barium swallow to investigate symptoms of dysphagia. Which radiological appearance is most consistent with the presence of tertiary contractions?
- a Local peristaltic wave elicited through oesophageal distension
  - b Local peristaltic wave identical to primary wave
  - c Orderly peristaltic sequence
  - d Stripping wave clearing the barium
  - e 'Yo-Yo' motion of the barium

5 Answer E: 'Yo-Yo' motion of the barium

Tertiary oesophageal contractions are non-propulsive motor events characterised by disordered up and down movement of the bolus without clearing of the oesophagus.

- 6 A 47-year-old male inpatient was investigated for vague symptoms of dysphagia. Both an upper gastrointestinal endoscopy study and a barium swallow were performed. What appearances most support the diagnosis of scarring secondary to reflux oesophagitis?
- a Fixed rigid folds with abrupt demarcation
  - b Fixed transverse folds with stepladder appearance of distal oesophagus
  - c Longitudinal folds >3 mm with evidence of submucosal inflammation
  - d Tortuous folds effaced by oesophageal distension
  - e Mass within the oesophageal wall

6 Answer B: Fixed transverse folds with stepladder appearance of distal oesophagus

The fixed folds are due to the scarring and are often in a transverse orientation. Reflux oesophagitis changes are most commonly seen in the distal oesophagus.

- 7 A patient underwent a barium swallow to investigate dysphagia. There was an indentation on the anterior aspect of the oesophagus anterior to the C5 vertebral body. The remainder of the study is unremarkable. What is the most likely cause for this appearance?
- a Oesophageal web
  - b Cricoid impression
  - c Oesophageal diverticulum
  - d Oesophageal neoplasm
  - e Oesophageal dysmotility

7 Answer B: Cricoid impression

- 8 A middle-aged man presented with symptoms of epigastric pain worse after eating. A diagnosis of Barrett's oesophagus was made. What are the most likely histological findings?
- a Columnar epithelium replacing stratified squamous epithelium
  - b Stratified squamous epithelium replacing columnar epithelium
  - c Transitional cell epithelium replacing stratified squamous epithelium
  - d Transitional cell epithelium replacing columnar epithelium
  - e Infiltration with adenocarcinoma

8 Answer A: Columnar epithelium replacing stratified squamous epithelium  
Barrett's is caused by chronic reflux damaging the epithelium and there are numerous associations. It is a pre-malignant condition hence follow-up is indicated.

- 9 Following a barium swallow, the reporting radiologist proposes a likely diagnosis of Barrett's oesophagus. Which of the following radiological findings are likely to have supported this diagnosis?
- a A short proximal stricture
  - b A long distal stricture
  - c An oesophageal diverticulum
  - d A large shallow ulcer
  - e An extrinsic compressive mass

9 Answer B: A long distal stricture

Common radiological findings in Barrett's oesophagus include: a long stricture in the mid or lower oesophagus, a large deep solitary ulcer (Barrett's ulcer), a fine reticular mucosal pattern, thickened irregular mucosal folds, a fine granular mucosal pattern and distal oesophageal widening.

- 10 A 60-year-old female patient complained of intermittent episodes of dysphagia to solid foods, which were particularly severe when eating steak. A contrast swallow demonstrated a thin constriction at the gastro-oesophageal junction. The narrowing was smooth, symmetrical and very short (2 mm). What is the most likely diagnosis?
- a Achalasia
  - b Barrett's oesophagus
  - c Lymphoma
  - d Oesophageal carcinoma
  - e Schatzki ring

10 Answer E: Schatzki ring

A Schatzki ring is a symptomatic, narrow-calibre stenotic ring at the gastro-oesophageal junction. It produces a typical episodic solid dysphagia, which is sometimes known as 'steakhouse syndrome'. The short height (typically 2–4 mm) and regular, symmetrical appearance help to distinguish it from malignant, peptic and other strictures.

- 20 A 17-year-old man with a history of recurrent chest infections developed dysphagia. The patient was not able to tolerate an endoscopy and he was referred for a barium meal. This demonstrated thickened, nodular duodenal mucosal folds. Review of a recent chest radiograph showed bronchiectasis mainly affecting the upper zones. What is the most likely underlying diagnosis?
- a Cystic fibrosis
  - b Kartagener syndrome
  - c Duodenal lymphoma
  - d Scleroderma
  - e Tuberculosis

**20 Answer A: Cystic fibrosis**

Cystic fibrosis affects the gastrointestinal tract in the majority of patients and manifestations include: meconium plugging, meconium ileus, distal intestinal obstruction, gastro-oesophageal reflux, thickened duodenal folds, small bowel dilatation, colonic stricturing, microcolon and pneumatosis intestinalis.

- 1 A 55-year-old male with a history of drug and alcohol abuse underwent an elective barium swallow for follow-up after surgery for laryngeal carcinoma. This demonstrated tortuous longitudinal filling defects in the lower third of a partially collapsed oesophagus. What is the most likely cause of these radiological findings?
- a Oesophageal varices
  - b Mucosal oedema associated with oesophagitis
  - c Oesophageal lymphoma
  - d Varicoid oesophageal carcinoma
  - e Achalasia

1 Answer A: Oesophageal varices

- 4 A 44-year-old female underwent an elective barium swallow to investigate a long history of reflux oesophagitis, which was poorly controlled with proton pump inhibitors. The report concluded that an inflammatory oesophagogastric polyp was identified, which was confirmed on endoscopy. What descriptive findings would be most likely to support this conclusion?
- a Large pedunculated mass with sausage-shaped appearance
  - b Plaque-like, sessile polyp
  - c Polypoid protuberance arising near cardia
  - d Sessile, slightly lobulated polyp
  - e Smooth submucosal mass in distal third of oesophagus

4 Answer C: Polypoid protuberance arising near cardia  
This is the most common appearance of an inflammatory polyp.



- 5 A patient from South America had an elective barium swallow to investigate weight loss. This showed diffuse oesophageal dilation. He has a history of cardiomyopathy and megacolon. What is the most likely diagnosis?
- a Amyloidosis
  - b Chagas disease
  - c Oesophagitis
  - d Scleroderma
  - e Systemic lupus erythematosus

5 Answer B: Chagas disease

Chagas disease characteristically involves diffuse oesophageal dilatation, megacolon and cardiomegaly.

- 6 A 35-year-old male presented with weight loss and dysphagia to both solids and liquids. A plain CXR and AXR were unremarkable and a contrast swallow showed a mildly dilated oesophagus with absent primary and secondary peristaltic waves. Tertiary contractions were seen and the lower oesophagus had a beak-like appearance. What is the most likely pathology?
- a Achalasia
  - b Adenocarcinoma
  - c Presbyesophagus
  - d Oesophageal spasm
  - e Scleroderma

6 Answer A: Achalasia

In achalasia the lower oesophageal sphincter fails to relax due to Wallerian degeneration of Auerbach's plexus. Relaxation only occurs when hydrostatic pressure exceeds that of the sphincter. There are three forms: (1) primary (idiopathic) or (2) secondary due to metastases or invasion of adenocarcinoma of the cardia, or (3) infectious (e.g., Chagas disease). The primary form classically occurs in 20–30 year olds, with dysphagia to both solids and liquids with weight loss. Two diagnostic criteria are absent primary and secondary waves, and failure of the lower oesophageal sphincter to relax. Other features are tertiary contractions, oesophageal dilatation and a bird's beak appearance. There may be an air fluid

level on plain films. Complications include recurrent aspiration and pneumonia in 10%, and an increased incidence of oesophageal malignancy. It is important to distinguish idiopathic achalasia from malignancy and oesophageal spasm.

- 7 A middle-aged male had a barium swallow to investigate dysphagia. This showed a smooth, lobulated, well-defined lesion that was subsequently found to be intramural. What is the most likely cause of this appearance?
- a Oesophageal polyp
  - b Squamous cell carcinoma
  - c Presbyesophagus
  - d Oesophageal leiomyoma
  - e Hiatus hernia

7 Answer D: Oesophageal leiomyoma

Leiomyomas are the commonest benign oesophageal neoplasm. They arise in smooth muscle and are therefore normally intramural. They are commoner in men and in the third to fifth decades. Most are asymptomatic and found incidentally, but they can cause dysphagia and pain.

- 8 A patient, who was known to be HIV positive, underwent a contrast swallow to investigate painful swallowing. A large oesophageal ulcer with a well-defined rim was demonstrated. The oesophageal mucosa was otherwise normal and there were no strictures or motility anomalies. What is the most likely diagnosis?
- a Barrett's oesophagus
  - b CMV oesophagitis
  - c Drug-induced oesophagitis
  - d Malignant ulceration
  - e Radiation oesophagitis

8 Answer B: CMV oesophagitis

The finding of a large solitary oesophageal ulcer in an HIV positive patient is most likely to represent either CMV oesophagitis or HIV oesophagitis. These two conditions are radiologically indistinguishable.

- 9 A previously fit and well 36-year-old man developed dysphagia to solid food and was referred for a contrast swallow. The reporting radiologist noticed large volume mediastinal lymphadenopathy and following contrast a large, polypoidal oesophageal mass was visible. What is the most likely diagnosis?
- a Oesophageal carcinoma
  - b Lymphoma
  - c Oesophageal haematoma
  - d Submucosal metastases
  - e Oesophageal varices

9 Answer B: Lymphoma

The presence of a polypoidal mass associated with mediastinal lymphadenopathy is most suggestive of oesophageal lymphoma. The oesophagus is the least common site of gastrointestinal lymphoma. More common sites include the stomach, small bowel and colon.

- 10 A 92-year-old woman presented with repeated episodes of aspiration pneumonia. A contrast swallow showed an oesophageal diverticulum. What feature would make a Zenker's diverticulum more likely than an alternative diagnosis?
- a Anterior position
  - b Multiple diverticula
  - c Origin below cricopharyngeus
  - d Origin at Killian's dehiscence
  - e Static appearance of diverticulum during swallow

10 Answer D: Origin at Killian's dehiscence

Zenker's diverticulum originates in the midline of the posterior oesophageal wall at a point known as Killian's dehiscence (above cricopharyngeus). It bulges during swallowing. Killian-Jamieson diverticula originate below cricopharyngeus.

- 11 A 54-year-old man with histologically confirmed adenocarcinoma at the gastro-oesophageal junction underwent FDG PET-CT for further staging. This demonstrated significant uptake ( $>2.5$  SUV) at the site of the tumour, an adjacent local nodal mass and gastro-hepatic and coeliac axis nodes. No other abnormal uptake was seen in the chest, abdomen or pelvis. What is the most appropriate staging for this patient?
- a N1 M1b
  - b N2 M0
  - c N1 M1a
  - d N1 M1b
  - e N1 Mx

11 Answer D: N1 M1b

Assuming the primary shows uptake then PET-CT allows accurate assessment of nodal disease particularly if they are normal by size criteria. The presence of a positive coeliac axis node in this patient upstages him to N1, M1b and makes him unsuitable for curative surgery. Tumour staging is assessed by endorectal ultrasonography (EUS).



- 2. A 32-year-old female patient attends for a barium swallow with a history of a sensation of food sticking in her throat. The barium swallow reveals uniform horizontally orientated folds in the lower oesophagus. There is a change in the texture of the mucosa 1 cm above the hiatus, which is sited 25 cm from the origin of the oesophagus. There is a slight smooth narrowing noted 2 cm above the hiatus, beyond which there is a slight dilatation of the oesophagus prior to it joining the stomach. Which of the following is an unusual finding?**

- A. The appearance of the oesophageal folds.
- B. The change in mucosal appearance 1 cm above the hiatus.
- C. The distance of the hiatus from the origin of the oesophagus.
- D. The slight narrowing 2 cm above the hiatus.
- E. The distal bulge just before the stomach.

- 2.A.** The appearance of the oesophageal folds.

The oesophageal folds are normally longitudinally orientated. Horizontally orientated folds are described as feline oesophagus. The change in mucosal appearance is the normal Z line – the squamo-columnar junction. The narrowing described is the A line at the origin of the vestibule of the distal oesophagus. The position of the hiatus is normally stated as being 40 cm. This is the distance from the teeth at gastroscopy – the distance from the origin of the oesophagus is 25 cm.

- 33. A 55-year-old man presents with dysphagia. He gives no history of weight loss and investigations reveal a normal full blood picture. He is referred for a barium swallow, which reveals a long stricture (several centimetres) in the mid to distal oesophagus with a fine reticular pattern adjacent to the distal aspect of the stricture and distal oesophageal widening. What is the most likely diagnosis?**

- A. Reflux oesophagitis.
- B. Candidiasis.
- ✓ C. Barrett's oesophagus.
- D. Oesophageal adenocarcinoma.
- E. Hiatus hernia.

### 33. C. Barrett's oesophagus.

This represents progressive columnar metaplasia of the distal oesophagus secondary to reflux oesophagitis. It is a premalignant condition associated with an increased risk of adenocarcinoma, 40-fold that of the general population. Strictures are more common in the distal, then mid oesophagus, rather than the classically described proximal third. The typical finding is of 1-cm-long strictures or ulceration with associated gastro-oesophageal reflux and hiatus hernia. These findings are non-specific and may result from a variety of other causes such as corrosive ingestion, nasogastric intubation, Crohn's disease, or neoplasm (primary or secondary). However, the presence of a fine reticular pattern extending distally from the stricture appears to be specific for Barrett's. A reticulonodular pattern has been described in patients with a superficial spreading adenocarcinoma, but this is rare and not classically associated with a stricture.

### 35. A 74-year-old female patient undergoes a barium swallow and meal as part of investigation of anaemia, as she refuses endoscopy. She denies any weight loss, dysphagia, or odynophagia. The swallow reveals multiple rounded plaques and nodules in the mid oesophagus. What is the most likely diagnosis?

- A. Oesophageal candidiasis.
- B. Herpes oesophagitis.
- ical*  
*seas* C. HIV oesophagitis.
- D. Glycogenic acanthosis.
- E. Cytomegalovirus oesophagitis.

### 35. D. Glycogenic acanthosis.

This is a common condition affecting elderly people. Cytoplasmic glycogen accumulates in the squamous epithelial lining of the oesophagus, producing the findings described in the question. Patients usually have no oesophageal symptoms, and the disease is not a precursor of malignancy (although extensive glycogenic acanthosis has been shown to be associated with Cowden's syndrome). The major differential diagnosis is candidiasis, but the plaques of candidiasis have a more linear, rather than rounded, appearance and it usually occurs in immunocompromised patients who complain of odynophagia. Options C, D, and E typically cause ulceration, not plaques.

*No Pathological symptoms from oesophagus*

**36. A 75-year-old woman presents with severe chest pain radiating to her back and some haematemesis. The surgical team have considered a differential diagnosis of aortic dissection or aorto-enteric fistula and requested a CT scan to assess the aorta. No aortic dissection is seen, but there is a long eccentric filling defect identified within the oesophageal wall, extending from the level of the carina to the gastro-oesophageal junction. This area did not enhance after contrast administration but did measure 75 HU on a pre-contrast scan. Barium swallow revealed a longitudinal impression on the oesophagus, which had resolved on a repeat swallow 6 weeks later. What is the most likely diagnosis?**

- A. Aorto-oesophageal fistula.
- B. Mallory–Weiss tear.
- C. Boerhaave syndrome.
- D. Oesophageal varices.
- E. Intramural haematoma of the oesophagus.

**36. E. Intramural haematoma of the oesophagus.**

Submucosal dissection of the oesophagus may be spontaneous or secondary to direct trauma or coagulopathy. Patients may present with chest pain, dysphagia, and nausea, often followed by haematemesis. The high attenuation in the wall of the oesophagus is the clue to the diagnosis. This feature and lack of enhancement are inconsistent with any alternative diagnosis. Follow-up with endoscopy is usually performed to exclude a predisposing pathological condition. The natural history is complete resolution without surgical intervention.



38. A patient with recently diagnosed oesophageal carcinoma is referred for endoscopic ultrasound (EUS) staging. This shows a hypoechoic area at 36 cm involving the mucosa extending into the submucosa, muscularis propria, and adventitia. It lies close to the aorta but there is no obvious invasion. There is a further hyperechoic lesion noted centrally within this area that only involves the mucosal layer. A subsequent staging CT scan shows an area of oesophageal thickening, which is in contact with 60% of the aorta and there is loss of fat plane between it and the pericardium. There is a lymph node noted adjacent to the oesophagus which measures 15 mm in diameter. Three 12-mm nodes are noted in the para-aortic region in the abdomen. There is a hypoattenuating lesion in segment six of the liver, which demonstrates nodular peripheral enhancement. A delayed scan shows that this lesion has filled in completely. For completion of staging, a PET-CT scan is performed and this shows increased uptake in the primary lesion. The lymph nodes in the abdomen have an SUV maximum of 3, and the para-oesophageal node has an SUV maximum of 13. There is mottled uptake in the liver. What is the radiological staging of this lesion? *SUV = Standard Uptake Value*
- A. T4, N1, M0.
  - B. T2, N1, M0.
  - C. T3, N1, M1.
  - D. T4, N2, M1.
  - E. T3, N1, M0.

38. E. T3, N1, M0.

The T staging of oesophageal tumours is most accurately carried out by EUS. The staging is T1 invading submucosa, T2 invading muscularis propria, T3 invading the adventitia, T4 invading adjacent structures. This is more accurate than the CT staging. Loss of fat planes on CT and the finding of tumour abutting the aorta—if it is in contact with less than 90% of the circumference—often does not preclude resectability, especially if these margins are clear on EUS. In the assessment of lymphatic spread, PET-CT has been shown to be more sensitive (81–99%) than CT alone (50–95%). Lymphatic spread is graded: N0, no spread; N1,

loco-regional spread. There is no N2 grading of oesophageal carcinoma as further lymphatic spread is considered M1. Whilst the abdominal nodes may be involved, the low SUV max is reassuring. The para-oesophageal node is almost certainly involved. The finding described in the liver is classical of a haemangioma and a mottled uptake in the liver is a normal finding on PET-CT, thus there is no evidence of metastatic disease radiologically.



**39. A 45-year-old woman is referred by her GP for a barium swallow for investigation of dysphagia. Gastro-oesophageal reflux into the lower third of the oesophagus is demonstrated and delicate transverse striations in the lower oesophagus are observed as a transient phenomenon. What is the next appropriate action appropriate for the radiologist?**

- A. Recommend a staging CT of chest and abdomen.
- B. Recommend oesophagoscopy and biopsy of the affected area.
- ☒ C. Recommend to the GP that the study was unremarkable but for mild reflux.
- D. Recommend referral for manometry.
- E. Recommend endoscopic ultrasound.

**39. C.** Recommend to the GP that the study was unremarkable but for mild reflux.

The findings described are in keeping with a 'feline' oesophagus. This is thought to be due to spasm in the muscularis mucosa. It is associated with gastro-oesophageal reflux, but is a benign entity.

**40. A 50-year-old woman presents with dysphagia. At barium swallow, contrast passes sluggishly into the oropharynx. No peristaltic waves are seen in the upper oesophagus. After swallowing, the lumen of the hypopharynx and upper oesophagus remain patent and distended. The lower oesophagus outlines normally. What is the most likely diagnosis?**

- A. Achalasia.
- B. Scleroderma.
- C. Polymyositis.
- D. Chagas disease.
- E. SLE.

#### 40. C. Polymyositis.

This condition and dermatomyositis affect skeletal muscle, which is found at the upper third of the oesophagus. These conditions begin in the upper oesophagus and extend caudally. Other findings at fluoroscopy include retention of barium in the valleculae and wide atonic pyriform fossae, regurgitation and nasal reflux, aspiration, and failure of contrast to progress in the upper oesophagus without the aid of gravity. Polymyositis and dermatomyositis are associated with underlying malignancy. The latter also involves a heliotrope rash and Gottron's papules on flexor surfaces.

The lower oesophagus is composed of smooth muscle and is affected by conditions such as scleroderma and SLE, which result in atony and lack of peristalsis in the lower two-thirds, beginning caudally and moving cranially. Achalasia and Chagas disease result in dilatation of the whole oesophagus, with a 'rat-tail' deformity at the lower end.

**56. A 30-year-old man with a long history of dysphagia presents with food impaction. He has a past medical history of allergies but nothing else of note. The food bolus passes spontaneously, and a water-soluble followed by a barium swallow are requested prior to endoscopy, to ensure there has been no perforation due to chicken/fish bones. The barium study reveals a moderately long stricture in the lower oesophagus, with multiple distinct ring-like indentations. What is the most likely diagnosis?**

- A. Idiopathic eosinophilic oesophagitis (IEE).
- B. Crohn's disease.
- C. Oesophageal carcinoma.
- D. Oesophageal perforation.
- E. Peptic stricture.

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**56.A. Idiopathic eosinophilic oesophagitis (IEE).**

The cause of this condition is uncertain, but most authors believe it occurs as an inflammatory response to ingested food allergens. A history of allergies is more closely correlated in children with the condition than in adults. Only a minority of adults with IEE have peripheral blood eosinophilia or eosinophilic gastroenteritis. The condition is most common in males aged 20–40 who have a history of dysphagia and recurrent food impactions. The appearance of the stricture, with its distinctive ring-like indentations, has been termed a 'ringed' oesophagus. These indentations are characterized by multiple closely spaced concentric rings that traverse the stricture. A similar finding may be seen in congenital oesophageal stenosis, which typically occurs in the same demographic group, with similar symptoms. The 'ringed' oesophagus is thus relatively specific for IEE, but is not a necessary finding (in the study quoted, it was only present in 7 of the 14 patients, although these 7 all had strictures). In peptic strictures, the fixed transverse folds are incomplete and further apart, producing a characteristic step-ladder appearance as a result of trapping of barium between the folds.

**67. A 70-year-old woman presents with a history of high dysphagia. Barium swallow reveals a barium-filled sac extending postero-inferior from the C5/6 level to the left of the upper oesophagus. What is the most likely diagnosis?**

- A. Pulsion diverticulum.
- B. Traction diverticulum.
- C. Zenker diverticulum.
- D. Early intramural diverticulosis.
- E. Oesophageal perforation.

**67. C. Zenker diverticulum.**

The findings are classical of a Zenker diverticulum or pharyngeal pouch, a pseudo-diverticulum of the posterior hypopharyngeal wall between the fibres of cricopharyngeus. 50% of cases occur in the seventh and eighth decades. Other symptoms can include halitosis, regurgitation of undigested food, aspiration pneumonia, oesophageal perforation, and carcinoma. It is associated with hiatus hernia, achalasia, and gastroduodenal ulcer. Treatment options include surgical excision, laser therapy, and endoscopy with stapling.

Traction diverticula classically occur in the mid-oesophageal region and in the past were most often a secondary manifestation of mediastinal fibrosis associated with TB. True oesophageal pulsion diverticula are most commonly in the epiphrenic region (last 10 cm of the oesophagus). Oesophageal perforation is more commonly iatrogenic, being rarely spontaneous (Boerhaave syndrome).

- 10 A young man presents to A&E with severe central chest pain following an episode of vomiting. On questioning he reports that he has been drinking alcohol the night before. The CT shows an eccentric hyperattenuating mass within the wall of the oesophagus.

**What is the most likely diagnosis?**

- (a) Mallory-Weiss tear
- (b) Intramural oesophageal dissection
- (c) Boerhaave syndrome
- (d) Transmural perforation
- (e) Intramural haematoma

**10 (e)**

The CT features indicate an intramural haematoma. Such patients often have a history of instrumentation, vomiting or food impaction and present with sudden onset pain, dysphagia or odynophagia. Haematemesis tends to occur later in the clinical course. Mallory-Weiss tear is a longitudinal mucosal laceration at the gastro-oesophageal junction. Dissection gives a double-barrelled appearance of the lumen due to a mucosal flap. Options (c) and (d) are full-thickness injuries and demonstrate mediastinal air or fluid on CT.



- 11 A 58 year old lady is referred for staging of a carcinoma in the middle third of the oesophagus.**

**Which of the following statements is true?**

- (a) Lymphatic drainage is likely to be via the upper abdominal lymph nodes
- (b) A PET study can reliably exclude the presence of involved loco-regional nodes
- (c) EUS is superior to PET-CT in the evaluation of loco-regional lymph nodes
- (d) Following treatment, EUS most commonly under-stages residual disease
- (e) The adrenal glands are the commonest site of metastatic disease

**11 (c)**

The upper and middle thirds of the oesophagus usually drain superiorly. Local staging is best performed with endoscopic US. PET-CT is the most accurate modality for distant lymph nodes or metastases but the intense uptake of the primary tumour may obscure local nodes. Following treatment, it is difficult to distinguish fibrosis from active tumour at EUS; PET is more accurate in this circumstance. The most common sites of metastases are, in order, liver, lungs bones and adrenal glands.

- 13 The junction of the squamous and columnar epithelium, seen on the barium swallow, is given what term?**

- (a) A-ring
- (b) B-ring
- (c) Schatzki ring
- (d) Barrett's line
- (e) Z-line

**13 (e)**

The A-ring is transient and muscular. The B- or Schatzki ring is a fixed mucosal/ muscular ring which may cause dysphagia or obstruction. Barrett's stricture is a complication of gastro-oesophageal reflux disease and is premalignant.

- 7 A 42 year old woman undergoes a barium swallow. This shows hold up of contrast medium in the lower oesophagus which resolves completely when the patient is given a cup of hot water.**

**What is the most likely diagnosis?**

- (a) Oesophageal varices
- (b) Diffuse oesophageal spasm
- (c) Presbyoesophagus
- (d) Primary achalasia
- (e) Intramural diverticulosis

**7 (d)**

Patients often report that hot drinks provide relief in achalasia. On imaging, the sphincter relaxes and the oesophagus is seen to clear.

- 17 A 46 year old man presents with dysphagia and weight loss. He is noted to have hyperkeratosis of the palms and soles. Barium swallow shows a malignant stricture of the mid oesophagus.**

**What is the most likely underlying diagnosis?**

- (a) Dermatomyositis
- (b) Epidermolysis bullosa
- (c) Pemphigus vulgaris
- (d) Scleroderma
- (e) Tylosis

**17 (e)**

Tylosis is an autosomal dominant inherited disorder characterized by thickening (hyperkeratosis) of the palms and soles, oral leukoplakia, and SCC of the oesophagus (in 95% by 70 yrs). Epidermolysis bullosa has a high association with SCC of the skin, there are rare case reports of associated oesophageal cancer. Pemphigus has a rare paraneoplastic form, typically associated with lymphoma. Dermatomyositis has a high association with various internal malignancies, in such cases it is thought to be a 'paraneoplastic' phenomenon, indicating the presence of cancer. Scleroderma results in oesophageal dysmotility, predisposing to reflux and increasing the risk of oesophageal cancer.

**22 A 47 year old woman undergoes a barium swallow. It is reported to show a diverticulum in the mid-oesophagus.**

**What is the most likely aetiology?**

- (a) Structural defect
- (b) Pulsion
- (c) Traction
- (d) Reflux
- (e) Achalasia

**22 (c)**

In the upper oesophagus, a pharyngeal pouch may be seen as a structural defect. In the mid-oesophagus, traction from adjacent mediastinal or pulmonary fibrosis is most common, whereas pulsion causes lower-third diverticula.

- 29 A 47 year old man attends for a barium swallow. This shows a lacelike pattern in the lower oesophagus above a lax lower oesophageal sphincter.**

**What is the most likely diagnosis?**

- (a) Barrett's oesophagus
- (b) Oesophageal varices
- (c) Oesophageal carcinoma
- (d) Oesophageal candidiasis
- (e) Normal oesophageal mucosa

**29 (a)**

Barrett's oesophagus is dysplasia of the lower oesophageal mucosa as a consequence of chronic gastro-oesophageal reflux disease. It is a premalignant condition and patients are usually enrolled in a surveillance programme.

- 72 With regard to squamous cell carcinoma of the oesophagus, which of the following statements is not true?**

- (a) It is associated with alcohol ingestion
- (b) It most commonly occurs in the middle third of the oesophagus
- (c) It is more common in Afro-Caribbean population
- (d) It is associated with smoking
- (e) It is more common in women

**72 (e)**

It is most commonly seen (50% cases) in the middle third, between the aortic arch and the inferior pulmonary vein. Smoking and alcohol are the major risk factors and appear to have a synergistic effect in increasing incidence. It is more commonly seen in men.

- 4) A 64-year-old man undergoes a barium meal examination for upper abdominal pain. A 10 mm ulcer is demonstrated at the gastric antrum. Which radiological feature would favour a diagnosis of malignant rather than benign gastric ulcer?
- a. round ulcer shape
  - b. ulcer crater confined within the gastric contour
  - c. gastric folds identified up to the edge of the ulcer crater
  - d. associated duodenal ulcer disease
  - e. uniform mucosal collar around a centrally located ulcer

4) b. \*\*\*\*

Many distinguishing features of gastric ulceration have been proposed in an attempt to classify gastric ulcers as benign or malignant, but there is significant overlap between the two categories. One reliable sign of a benign ulcer is the projection of the ulcer outside the gastric contour in profile, due to excavation into the mucosal wall. In contrast, a malignant ulcer occurring within a tumour mass does not usually extend beyond the confines of the gastric wall. Other features indicative of benignity include a round, centrally located ulcer with a uniform collar of oedematous mucosa, gastric folds extending to the edge of the ulcer crater and associated duodenal ulcer disease.

- 21) A 65-year-old woman, with a history of previous partial gastrectomy 10 years earlier, presents with upper abdominal pain and early satiety. She undergoes a double-contrast barium meal, which demonstrates a 4 cm intraluminal, mottled filling defect in the gastric remnant with no fixed attachment to the gastric wall. What is the most likely diagnosis?
- a. suture granuloma
  - b. trichobezoar
  - c. phytobezoar
  - d. gastric carcinoma
  - e. villous adenoma



21) c. \*\*\*\*

Bezoars are masses of accumulated ingested material forming in the stomach or intestines. **Phytobezoars** are the commonest type, composed of poorly digested fibre and vegetable matter. They are seen particularly in patients with previous gastric surgery, probably due to diminished gastric emptying. Patients may be asymptomatic or present with early satiety or symptoms of gastritis, as phytobezoars are irritant. Occasionally, they may obstruct the stomach with a ball-valve mechanism. They are seen as relatively mobile filling defects, the interstices of which are filled with barium. **Trichobezoars** are composed of hair, and are usually larger, and found in younger patients, particularly those with a psychiatric history. **Gastric carcinoma, villous adenoma and suture granuloma** are all causes of gastric filling defects but have a constant relationship to the gastric wall.

23) A 54-year-old man with known metastatic malignant melanoma presents with epigastric pain and haematemesis. What is the most likely finding in the stomach on double-contrast barium meal?

- a. multiple submucosal nodules with central ulceration
- b. solitary ulcerated mass in the gastric antrum
- c. linitis plastica
- d. solitary, well-defined, pedunculated filling defect
- e. thickened tortuous gastric folds

23) a. \*\*\*

GI tract metastases are seen in 4–8% of patients with malignant melanoma. The small intestine is most commonly affected, followed by the colon and stomach. **Typical features are of multiple submucosal nodules, with a target appearance due to central ulceration.** This appearance is particularly seen with malignant melanoma metastases but may also be seen with gastric metastases from breast, lung and renal cell carcinoma. **Other common appearances of gastric metastases include linitis plastica in 20%, most typically from breast cancer, and a solitary mass in 50%.**

53) A 66-year-old woman with a known large para-oesophageal hiatus hernia presents with sudden onset of severe epigastric pain and vigorous retching without production of vomitus. Passage of a nasogastric tube is unsuccessful. Plain abdominal radiograph demonstrates a markedly distended stomach in the left upper quadrant extending into the chest. What is the most likely diagnosis?

- a. pyloric stenosis
- b. 'cup-and-spill' stomach
- c. acute gastric volvulus
- d. acute gastric dilatation
- e. paraduodenal hernia

53) c. \*\*\*

Acute gastric volvulus is abnormal rotation of one part of the stomach around another part, which may be classified as organoaxial, mesenteroaxial or combination type, depending on the axis of rotation. Predisposing factors include ligamentous laxity, hiatus hernia and diaphragmatic eventration. The classic presentation is with the Borchardt triad of sudden severe epigastric pain, intractable retching with no vomitus produced, and inability to pass a nasogastric tube into the stomach. Other plain film findings include unexpected location of the gastric bubble and air-fluid levels in the mediastinum or upper abdomen, but definitive diagnosis is by barium meal. The condition is a surgical emergency, as it may result in gastric ischaemia or perforation. Acute gastric dilatation and pyloric stenosis may result in gastric distension on plain film, but would not present with intractable retching or difficulty with nasogastric tube passage. A 'cup-and-spill' stomach is an anatomical variant on barium meal, which may simulate an organoaxial volvulus. A paraduodenal hernia usually presents acutely as small bowel obstruction.



75) A 48-year-old man presents with epigastric pain, weight loss and peripheral oedema. Blood tests demonstrate hypoalbuminaemia. At barium meal the stomach is well distended, but there is poor mucosal coating. Markedly enlarged and tortuous gastric rugae are seen in the fundus and body of the stomach, with sparing of the antrum. What is the most likely diagnosis?

- a. lymphoma
- b. Ménétriér's disease
- c. gastric carcinoma
- d. Zollinger–Ellison syndrome
- e. eosinophilic gastroenteritis

75) b. \*\*\*\*\*

Ménétriér's disease is characterized by mucosal hypertrophy of the fundus and body of the stomach, with excessive mucus secretion and a protein-losing enteropathy. There may be associated gastric ulceration. Barium meal shows impaired mucosal coating due to hypersecretion and marked gastric fold thickening, though the stomach distends normally. The stomach is the commonest site for gastrointestinal lymphoma, which may be polypoid, ulcerating or infiltrative. The infiltrative form may cause pronounced thickening of gastric folds, with preserved stomach distensibility, but hypersecretion is not a feature. Infiltrating gastric carcinoma may also cause thickened gastric folds, but associated desmoplastic reaction results in a rigid, poorly distensible stomach. Zollinger–Ellison syndrome results in hypersecretion of gastric acid, which impairs mucosal coating of barium, and is associated with ulceration and enlargement of rugal folds, but hypoproteinaemia is not a feature. Eosinophilic gastroenteritis may cause enlarged gastric folds and be associated with protein-losing enteropathy if the small bowel is involved. However, the antrum is most commonly involved.

76) On a barium meal examination, the incisura angularis marks the border between which structures?

- a. lesser and greater curvatures of the stomach
- b. antrum and pylorus of the stomach
- c. fundus and body of the stomach
- d. body and antrum of the stomach
- e. oesophagus and the stomach

76) d. \*\*\*

The stomach is divided into the fundus, body, antrum and pylorus. The fundus is that part of the stomach extending superiorly and to the left of the cardiac orifice. The body extends from the cardiac orifice to the incisura angularis, which is a constant notch at the lower end of the lesser curvature marking the border between the body and the antrum of the stomach. The antrum extends from the incisura angularis to the proximal pylorus.

81) A 41-year-old woman with morbid obesity presents with a plateau in weight loss 12 weeks after laparoscopic gastric banding. She undergoes a contrast swallow, which demonstrates concentric dilatation of the neostomach with a widely patent stoma. What is the most appropriate management?

- a. no action necessary
- b. nutritional advice
- c. prompt decompression of the stoma by the radiologist
- d. fluoroscopically guided band inflation
- e. surgical replacement of the gastric band

81) b. \*\*\*\*

Laparoscopic gastric banding involves laparoscopic placement of an inflatable gastric band across the proximal stomach, forming a small fundal neostomach or pouch. The band is connected to a subcutaneous port that can be accessed percutaneously to allow inflation or deflation of the band and adjustment of stomal width and degree of hold-up. The commonest postoperative complication is dilatation of the pouch.

Three main types are described. (1) Acute concentric pouch dilatation is due to band overinflation, and is seen as a prestenotic dilatation proximal to an obstructed stoma. It presents as acute dysphagia and requires prompt decompression of the stoma. (2) Chronic concentric pouch dilatation with a widely patent stoma is seen in patients who continue to overfill their neostomach after surgery. Nutritional advice is

required. (3) Eccentric pouch dilatation occurs due to slippage of the band, and requires complete decompression and surgical replacement of the band. A plateau in weight loss may also be due to loss of effect of band tightening. At fluoroscopy, fluid may be injected to tighten the band to achieve an optimal stomal width of 3–4 mm.

89) A 69-year-old man undergoes staging of gastric carcinoma diagnosed at upper gastrointestinal endoscopy. CT of the abdomen demonstrates focal gastric wall thickening with extension into the perigastric fat, but no invasion of adjacent structures. Five local lymph nodes measuring 10–12 mm in short axis diameter are identified. There is no distant metastatic disease. What is the TNM staging of the tumour?

- a. T2 N0 M0
- b. T2 N1 M0
- c. T2 N2 M0
- d. T3 N1 M0
- e. T3 N2 M0



89) d. \*\*\*\*

T3 tumours penetrate the subserosa but do not invade adjacent structures. On CT, this may be appreciated as blurring of the tumour margin or wide reticular strands radiating from the tumour edge. Nodal staging depends on the number of regional nodes visible, with nodes larger than 8mm being regarded as pathological. The presence of 1–6 regional nodes results in a stage of N1, with 7–15 nodes and > 15 nodes representing nodal stages of N2 and N3 respectively. Non-regional nodes such as para-aortic and retropancreatic nodes are considered M1 disease.

99) A 65-year-old man presents with early satiety and bloating, and undergoes barium meal. This demonstrates a smoothly marginated, 15 cm mass in the body of the stomach, making an obtuse angle with the gastric wall. CT demonstrates peripheral enhancement of the mass with central areas of low attenuation and extragastric extension into the lesser sac. There is no associated lymphadenopathy. What is the most likely diagnosis?

- a. gastrointestinal stromal tumour
- b. gastric carcinoma
- c. gastric lymphoma
- d. adenomatous polyp
- e. gastric carcinoid

99) a. \*\*\*\*

Gastrointestinal stromal tumours are the commonest mesenchymal tumours of the gastrointestinal tract. They are characterized by expression of KIT, a tyrosine kinase growth factor receptor, which distinguishes them from leiomyomas and leiomyosarcomas. They occur

most commonly in the stomach, and have the classic appearance of a submucosal mass on barium meal, forming an obtuse angle with the gastric wall in profile. Focal areas of ulceration are seen in 60%. On CT, the tumours measure up to 30 cm and are often predominantly extragastric. Typical features are of peripheral enhancement, with central low attenuation representing necrosis, haemorrhage and cyst formation. Lymphadenopathy is not a feature. Gastric carcinoma and lymphoma rarely demonstrate exophytic growth and commonly have associated lymphadenopathy. Adenomatous polyps are mucosal lesions. Gastric carcinoid is usually seen in the antrum and characteristically shows associated ulceration.

26. A 50 year old male is admitted with epigastric pain, diarrhoea and vomiting. Ascites is present clinically. Serum albumin is low and the patient is anaemic. Colonoscopy is normal but the patient is intolerant of upper gastro-intestinal endoscopy. Barium meal reveals a normal antrum but elsewhere there are diffusely thickened and enlarged gastric folds despite good gastric distension. Which one of the following is the most likely diagnosis?
- a. Gastric lymphoma *involve antrum also*
  - b. Menetrier's disease
  - c. Gastric adenocarcinoma
  - d. Acute gastritis
  - e. Linitis plastica

26. b. Menetrier's disease

Menetrier's disease is a condition characterised by gastric mucosal hypertrophy and protein-losing enteropathy. It is often associated with anaemia. The changes are most marked along the greater curve and the antrum is spared in approximately 50% of cases. Gastric lymphoma typically involves the antrum. With gastric adenocarcinoma and linitis plastica, stomach distension is not typically preserved.

- 36.) A six week old child has an ultrasound scan of the abdomen performed for non-bilious projectile vomiting. Which one of the following features would support a diagnosis of infantile pylorospasm over a diagnosis of hypertrophic pyloric stenosis?
- a. Pyloric muscle wall thickness of 2 mm
  - b. Pyloric canal length of 19 mm
  - c. Target sign
  - d. Antral nipple sign
  - e. Transverse pyloric diameter of 14 mm

**36. a. Pyloric muscle wall thickness of 2 mm**

Hypertrophic pyloric stenosis presents between four and six weeks of life with non-bilious vomiting, typically in first-born males. A palpable olive-shaped mass is a sign with reported sensitivity of up to 80%, but ultrasound is the most frequently used imaging modality. Typical ultrasound features include the target sign (central hyperechoic mucosa with surrounding hypoechoic pyloric muscle), the nipple sign (pyloric mucosa indenting the gastric antrum), pyloric canal length >16 mm, transverse pyloric diameter >13 mm and pyloric muscle wall thickness >3 mm. Pyloric stenosis can be difficult to differentiate radiologically from infantile pylorospasm. Typically with pylorospasm the appearances change with time, and so if the pyloric muscle thickness is measured at less than 3 mm this makes infantile pylorospasm the more likely diagnosis.

- 13 A staging CT was performed on a 49-year-old gentleman with a histologically proven adenocarcinoma of the fundus of his stomach. The CT showed invasion of the adjacent contiguous structures but no invasion of adjacent organs, the diaphragm or the abdominal wall. Multiple prominent local nodes were evident and a 1.3-cm (short axis) lymph node was seen in the left para-aortic region. No distant metastases were visible. What is the radiological staging?
- a T4b N2 M0
  - b T4a N3 M0
  - c T3 N3 M0
  - d T3 N3 M1
  - e T4a N2 M0

13 Answer B: T4a N3 M0

- 14 A six-week-old male infant presented with non-bilious projectile vomiting for several days. The baby was dehydrated and found to have a significant electrolyte disturbance. His fontanelles were sunken and a small olive-shaped mass was felt in the upper abdomen. What finding would be expected on ultrasound?
- a Delayed gastric emptying
  - b Exaggerated peristaltic waves
  - c Pyloric canal length 16 mm; pyloric muscle wall thickness 2 mm
  - d Pyloric transverse diameter 15 mm and presence of the cervix sign
  - e Pyloric volume 1.3 cu cm and presence of target lesion sign

14 Answer D: Pyloric transverse diameter 15 mm and presence of the cervix sign  
The 'cervix sign' is the indentation of muscle mass on the fluid-filled antrum in longitudinal section and is seen in pyloric stenosis. Maximal dimensions of the canal on USS are 17 mm in length, 3 mm wall thickness, 13 mm in diameter and volume of 1.4 cu cm.

- 15 A patient had recently been diagnosed with gastric carcinoma that had been staged locally as T2 disease. To what extent has the tumour penetrated through the wall?
- a Penetrated thorough the serosa
  - b Invading adjacent organs
  - c Limited to the submucosa
  - d Limited to the serosa
  - e Limited to the mucosa

15 Answer D: Limited to the serosa



- 16 An 80-year-old male underwent a barium meal to investigate epigastric pain and early satiety. There was a narrow, tubular stomach with a lack of rugal folds in the proximal stomach and a smooth greater curve. What is the most likely diagnosis?
- a Zollinger-Ellison syndrome
  - b Linitis plastica
  - c Atrophic gastritis
  - d Menetrier's disease
  - e Corrosive gastritis

16 Answer C: Atrophic gastritis

The incidence of atrophic gastritis increases with age and symptoms may include epigastric pain and early satiety. Radiological features are a narrow tubular stomach and a reduction in the normal gastric folds.

- 18 A 24 year old developed crampy abdominal pain and diarrhoea over the course of several months and lost a significant amount of weight. He was reluctant to undergo endoscopy and was referred for a barium meal which showed narrowing of the gastric antrum and a cobblestone appearance of the gastric and duodenal mucosa. What is the most likely diagnosis?
- a Crohn's disease
  - b Submucosal metastases
  - c Zollinger-Ellison syndrome
  - d Erosive gastritis
  - e Gastric carcinoma

18 Answer A: Crohn's disease

Although Crohn's disease more frequently affects the small bowel, involvement of the stomach and duodenum occurs in up to 10% of patients. Typical appearances include aphthoid ulcers, erosions, cobblestone mucosa and thickened duodenal folds.

- 19 A middle-aged man underwent a barium meal which showed an abnormality of the gastric wall with mural thickening, irregularity, reduced distensibility and absent peristalsis. What is the most likely underlying diagnosis?
- a Amyloid
  - b Pancreatic carcinoma
  - c Radiation therapy
  - d Scirrhus cancer
  - e Syphilis

19 Answer D: Scirrhus cancer

The listed radiological features are typical of linitis plastica (leather bottle stomach) of which scirrhus cancer is the most common cause. Other causes include: other tumours (lymphoma, metastases, pancreatic carcinoma), inflammation (erosive gastritis, radiation therapy), infiltrative disease (sarcoid, amyloid, intramural haematoma) and infection (TB, syphilis).

- 13 An 88-year-old lady presented with a tender distended abdomen. A dilated viscus was visible in the left upper quadrant on plain radiography with a long fluid level. There was leftward and upward displacement with a raised left hemidiaphragm and little gas elsewhere in the abdomen. What is the most likely diagnosis?
- a Air swallowing
  - b Caecal volvulus
  - c Gastric outlet obstruction
  - d Gastric volvulus
  - e Paralytic ileus

13 Answer D: Gastric volvulus

Gastric volvulus, although rare, is more common in the elderly population. It may result from twisting in the longitudinal, transverse or mesenteric axis. The dilated stomach usually contains a long fluid level and is displaced upwards and to the left, causing a raised left hemidiaphragm.

- 14 An eight-year-old girl presented with a month's history of abdominal pain and vomiting. An abdominal ultrasound demonstrated a cyst with an inner echogenic layer and outer hypoechoic layer of muscle in the region of the greater curvature of the stomach. What is the most likely diagnosis?
- a Gastric duplication cyst
  - b Mesenteric cyst
  - c Oesophageal duplication cyst
  - d Pancreatic cyst
  - e Pancreatic pseudocyst

14 Answer A: Gastric duplication cyst

This two-layered appearance is classic of gastric duplication cyst. Sixty-five per cent are in the region of the greater curvature. Most present in infancy with 75% being detected before the age of 12 years.

- 15 A gastric ulcer was visible during a barium meal. What feature would favour a benign aetiology over malignancy?
- a Irregular contour
  - b Hampton's line
  - c Shallow ulcer
  - d No protrusion beyond stomach
  - e Asymmetrical mass

15 Answer B: Hampton's line

Benign features	Malignant features
Protrudes beyond stomach	No protrusion
Deep	Shallow
Round/oval	Irregular shape
Symmetrical	Asymmetrical
Smooth collar	No collar
Hampton's line present	Hampton's line absent
Smooth even folds	Irregular nodular folds
No adjacent masses/nodules	Adjacent nodules
Heals completely	Rarely completely heals

- 16 A patient was diagnosis with Menetrier's disease on histology. What radiological appearance would support this diagnosis?
- a Absence of gastric folds in the proximal stomach
  - b Thickened folds in the proximal stomach
  - c Multiple gastric ulcers
  - d Rigid stomach wall
  - e Aphthoid ulcers

16 Answer B: Thickened folds in the proximal stomach

This is hypertrophic gastritis and may present with epigastric pain, achlorydia, and protein loss. There are thickened gastric folds mainly in the proximal stomach and greater curve. Unlike in a malignant process the stomach wall does not become rigid, but endoscopy and biopsy are usually necessary for diagnosis.

- 17 A patient underwent a barium meal which demonstrated multiple filling defects. Upper GI endoscopy confirmed multiple gastric polyps, which were biopsied. What is the histology most likely to show?
- a Adenomatous polyps
  - b Hamartomatous polyps
  - c Hyperplastic polyps
  - d Leiomyomas
  - e Metastases

17 Answer C: Hyperplastic polyps

Hyperplastic polyps occur mainly in the body and fundus of the stomach but also randomly throughout the stomach. They normally measure under 1 cm in size, but rarely be 3–10 cm. This type makes up 80–90% of gastric polyps.



- 18 A 50-year-old publican with a history of back pain developed retrosternal pain and melaena. He visited his doctor and, following a negative urea breath test, was referred for a barium meal. This showed linear streaks and dots of barium within the gastric mucosa, preferentially affecting the gastric antrum. What is the most likely diagnosis?
- a Crohn's disease
  - b Gastric varices
  - c Gastric carcinoma
  - d Emphysematous gastritis
  - e Erosive gastritis

18 Answer E: Erosive gastritis

Erosive (haemorrhagic) gastritis is associated with peptic disease, infection and Crohn's disease. Non-steroidal anti-inflammatory drugs are a common underlying cause, which may have been used to treat his back pain. Contrast studies may show complete or incomplete erosions. Complete erosions show a spot of barium surrounded by a radiolucent ring of oedema (target lesion). Incomplete erosions show dots and linear streaks of barium without associated oedema.

- 19 A 30-year-old man with no previous medical or surgical history presented to the Emergency Department with severe epigastric pain. He was retching but was unable to vomit. Plain radiographs demonstrated a large hiatus hernia and grossly distended stomach and an abdominal CT revealed features of a gastric volvulus associated with the hiatus hernia. What feature would suggest an organoaxial volvulus?
- a Diaphragmatic rupture
  - b Evidence of gastric ischaemia
  - c Gas in the stomach wall
  - d Greater curvature located cranially
  - e The fundus positioned caudal to the antrum

**19 Answer D: Greater curvature located cranially**

Features	Organoaxial volvulus	Mesenteroaxial volvulus
Mechanism	Rotation around long axis of stomach	Rotation around short axis
Appearance	Greater curvature rotated cranially – 'upside-down' stomach	Fundus is caudal to antrum

*(continued)*

Features	Organoaxial volvulus	Mesenteroaxial volvulus
Predisposed	Adults with large hiatal hernia	Large portions of stomach, above diaphragm (e.g. traumatic diaphragmatic rupture in children)
Complications	Rare	Common (obstruction, ischaemia)

- 14** A 37-year-old male presented with gastric outlet obstruction. He had a history of epigastric pain related to food and an abdominal CT showed a dilated stomach with irregular inflammatory narrowing in the distal stomach. What is the most likely cause?
- a Antral carcinoma
  - b Crohn's disease
  - c Peptic ulcer disease
  - d Sarcoidosis
  - e Syphilis

**14 Answer C: Peptic ulcer disease**

In gastric outlet obstruction caused by inflammatory narrowing 60–65% is caused by peptic ulcer disease. This is particularly likely in a patient with a history of symptoms probably related to peptic ulcer disease.

- 15 A 55-year-old male presented with severe symptoms of reflux. A barium study showed thickened gastric rugae, duodenal and jejunal folds and multiple peptic ulcers. His serum gastrin level was elevated. What is the most likely diagnosis?
- a Barrett's oesophagus
  - b Oesophageal Crohn's disease
  - c Zollinger-Ellison syndrome
  - d Pancreatitis
  - e *Helicobacter pylori* infection

15 Answer C: Zollinger-Ellison syndrome

Zollinger-Ellison syndrome is secondary to a functional pancreatic islet cell tumour producing gastrin. It causes gastric hypersecretion, which leads to multiple ulcers and a diffuse inflammatory response accounting for the thickened folds.

- 17 A 50-year-old landscape gardener presented with abdominal pain and was assessed with a CT scan on which gastric mucosal irregularity was noted. His pain settled with conservative management and he was followed up with a barium meal as an outpatient, which showed multiple target ('bull's-eye') lesions in the stomach.
- a Pancreatic 'rest'
  - b Gastric Crohn's disease
  - c Gastric carcinoma
  - d Neurofibroma
  - e Submucosal metastases

17 Answer E: Submucosal metastases

The commonest cause of 'bull's-eye' lesions in the stomach is submucosal metastases and of these the commonest primary tumour is malignant melanoma. Other causes of gastric 'bull's-eye' lesions include: leiomyoma, pancreatic rest and neurofibroma.

- 18 A patient was noted to have an abnormal appearance of the stomach wall on abdominal CT. A barium meal was subsequently performed and a diagnosis of ectopic pancreatic tissue (pancreatic rest) was considered. What finding would be most typical of this diagnosis?
- a Dots and linear streaks of barium
  - b Featureless gastric mucosa
  - c Multiple aphthous ulcers
  - d Polypoid fundal mass
  - e Submucosal umbilicated mass

18 Answer E: Submucosal umbilicated mass

Pancreatic rests (ectopic pancreas) typically occur in the greater curvature, pylorus, duodenal bulb or proximal jejunum. They manifest as submucosal nodules between 1 and 5 cm in size. Central umbilication is often present, representing the orifice of the filiform duct.

- 19 Following an episode of haematemesis a 48-year-old man visited his doctor. He admitted several months of dyspeptic symptoms, some weight loss and said he had been drinking up to a bottle of spirit daily. He was referred for an endoscopy, which he was not able to tolerate. Consequently, a barium meal was performed which showed a large ulcer within an oedematous mound on the greater curvature. What further feature would suggest a malignant ulcer?
- a Carman's (meniscus) sign
  - b Central location of ulcer within mound
  - c Extension of mucosal folds to crater edge
  - d Hampton's line
  - e Thin mucosal folds

19 Answer A: Carman's (meniscus) sign

Radiological signs of a malignant ulcer include: thick irregular mucosal folds, projection of ulcer within luminal surface, Carman's (meniscus) sign, eccentric location of ulcer in tumour mound, a thick nodular irregular collar and limited gastric distensibility and peristalsis.

6. A patient presents to an outpatient barium meal list with a history of epigastric discomfort and weight loss of 8 kg over 6 months. The barium meal reveals an ulcer on the greater curve of the stomach, near the pylorus. This ulcer has a surrounding mound. It is demonstrated to project slightly beyond the lumen of the stomach. There is a thin line noted which crosses the base of the ulcer and a degree of retraction of the greater curve around the ulcer. What type of ulcer is this likely to be?

- A. Benign due to the line noted crossing the base of the ulcer.
- B. Benign due to the ulcer projecting beyond the lumen of the stomach.
- C. Benign due to the surrounding mound.
- D. Malignant due to the finding of scar retraction of the greater curve.
- E. Malignant due to being found on the greater curve.

6.A. Benign due to the line noted crossing the base of the ulcer.

This line—Hampton's line—represents undermining of the mucosa by the more vulnerable submucosa. It is not commonly seen, but is taken to be virtually diagnostic of a benign ulcer when present. Projection beyond the lumen and a symmetrical mound are features of a benign ulcer along with smooth radiating mucosal folds. Scar retraction can be seen with benign ulcers. Both benign and malignant ulcers are more commonly seen on the lesser curve.

13. A patient is undergoing a barium meal. What is the best position to place the patient in to see an en face view of the lesser curve? sh

- A. Left lateral. *Fundus*
- ☒ B. Left anterior oblique (LAO). *Fundus*
- C. Supine. *Greater curve and antrum*
- D. Right anterior oblique (RAO). *Body and antrum*
- E. Right lateral. *Not routinely used*

13.B. LAO.

The right lateral position is not routinely used. The RAO shows the body and antrum of the stomach. Supine positioning shows the greater curve and the antrum of the stomach. Left lateral position shows the fundus of the stomach.



16. A 68-year-old male patient has a 20-year history of RA. During a recent flare he was commenced on steroid therapy, although this has now been discontinued. The patient is now complaining of mild abdominal discomfort, diarrhoea, and mild weight loss. A barium meal is performed, but is suboptimal, as the patient is poorly mobile. Within the limitations of the study, there is reduced peristalsis in the oesophagus and mild reflux. The antrum of the stomach is felt to be mildly narrowed and rigid. Thickened rugal folds are noted. A subsequent small bowel series is carried out. The jejunal folds measure 4 mm and the ileal folds appear more plentiful and measure 3 mm. Contrast is present in the caecum at 4 hours. Spot screening of the terminal ileum reveals the same findings as those described above. What is the most likely diagnosis?
- A. Gastric erosions.
  - B. Whipple's disease.
  - C. Mastocytosis.
  - D. Amyloidosis.
  - E. Crohn's disease.

**16. D. Amyloidosis.**

This patient probably has amyloidosis secondary to prolonged RA. GI involvement is more common in primary (70%) than secondary (13%) amyloidosis. Nevertheless, the small bowel is involved in 74% of cases of GI amyloidosis and secondary amyloidosis is the most common type of amyloid disease. Amyloidosis is secondary to the deposition of insoluble amyloid protein in soft tissues and organs. In primary amyloidosis the heart (90%), followed by the small bowel and the lungs (70%), are the most commonly affected organs. The kidneys are affected in 90% of cases of secondary amyloidosis. Amyloidosis classically causes a diffuse thickening of bowel folds. It may cause dilated bowel folds, if the myenteric plexus is involved. The main differential for amyloid is Whipple's disease and intestinal lymphangiectasia. Whipple's disease does not cause bowel dilatation or rigidity, as described in the antrum in this patient. Crohn's disease can also present with thickened folds, but it is more commonly focal with the most pronounced abnormality in the terminal ileum. Ulceration is also commonly seen in Crohn's, but 68 years old would be a late first presentation for Crohn's. Whilst option A is true, this is not what the question asked. Patients with mastocytosis most commonly present in infancy.

42. A 45-year-old man presents with acute abdominal pain. He has pyrexia and his inflammatory markers are raised. The surgical team request a CT scan of abdomen for 'perforation'. The CT reveals inflammatory change in the anterior pararenal space. Which of the following is least likely to be the underlying cause for the CT finding?

- A. Acute pancreatitis.
- B. Gastric ulceration.
- C. Diverticulitis of the descending colon.
- D. Duodenal perforation.
- E. Perforation of ascending colon due to neoplasm.

42. B. Gastric ulceration.

The anterior pararenal space extends between the posterior parietal peritoneum and the anterior renal fascia (Gerota's fascia). It is bounded laterally by the lateral conal fascia. The pancreas, second and third parts of the duodenum, and ascending and descending colon are located within the anterior pararenal space, and disease in this space usually arises in these organs. The stomach is intraperitoneal.

4 Emphysematous gastritis is most commonly associated with which of the following organisms?

- (a) *S. pneumoniae*
- (b) *C. difficile*
- (c) *S. milleri*
- (d) *E. coli*
- (e) *S. aureus*

4 (d)

*Clostridium welchii* is another common cause of this unusual condition. *S. pneumoniae*, *S. aureus* (and *E. coli*) may cause non-emphysematous gastritis. *S. milleri* is a cause of liver abscesses and *C. difficile* colitis.

**21 Which of the following is not a recognised cause of gastric fold thickening?**

- (a) Adult hypertrophic pyloric stenosis
- (b) Lymphoma
- (c) Gastritis
- (d) Menetrier's disease
- (e) Zollinger-Ellison syndrome

**21 (a)**

This has similar appearances to infantile hypertrophic pyloric stenosis but may be associated with ulceration. Differentiation from malignancy in the antrum may also be difficult.

**32 Where do gastrointestinal stromal tumours (GIST) most commonly arise?**

- (a) Oesophagus
- (b) Stomach
- (c) Small intestine
- (d) Colon
- (e) Appendix

**32 (b)**

Approximately 60% arise in the stomach, 30% in the small bowel, 7% in the ano-rectal region and the remainder in the oesophagus and colon.

- 35 A 39 year old man presents with epigastric pain, diarrhoea, PR bleeding, exhaustion, and fatigue. He is noted to have a swelling of the jaw. On examination there are several calvarial lumps. CT head shows sebaceous cysts and bone lesions which are likely osteomas. OGD shows gastric hamartomas, colonoscopy shows multiple polyps throughout the colon.

What is the most likely diagnosis?

- (a) Cowden disease
- (b) Gardner's syndrome
- (c) Lynch syndrome
- (d) Peutz-Jegher's syndrome
- (e) Turcot's syndrome

35 (b)

5% of colorectal carcinoma is genetic in origin; the most common inherited syndromes being familial adenomatous polyposis and hereditary non-polyposis colorectal cancer (Lynch syndrome; HNPCC). **Gardner's syndrome** is associated with polyposis in the colon (100%), duodenum (90%) and, rarely other bowel segments; there is an association with gastric hamartomas, osteomas in calvarium/ mandible, and soft tissue tumours (30%). **Turcot syndrome** is a rare condition which is also associated with CNS gliomas and medulloblastomas. **Peutz-Jeghers syndrome** consists of hamartomas throughout the GI system with the rare potential for malignant transformation, and perioral pigmentation. **Cowden disease** has hamartomas, gingival hyperplasia, oral papillomas, muco-cutaneous pigmentation and an increased risk of breast and thyroid malignancy.



**20 Which of the following conditions does not predispose patients to gastric volvulus?**

- (a) Hiatus hernia
- (b) Phrenic nerve palsy
- (c) Previous sigmoid volvulus
- (d) Diaphragmatic eventration
- (e) Splenic abnormalities

**20 (c)**

Other predisposing factors include gastric distension and traumatic diaphragmatic hernia. It is more commonly seen in the elderly and presents with acute upper GI obstruction and wretching without producing vomitus. It is important to assess the patient for signs of ischaemia on cross-sectional imaging as this is a surgical emergency.

**31 Which of the following is not a recognised complication of partial gastrectomy?**

- (a) Bezoar
- (b) Gastric carcinoma
- (c) Fistula formation
- (d) Gastric lymphoma
- (e) Marginal ulceration

**31 (d)**

Partial gastrectomy was previously a common operation for the treatment of peptic ulcer disease, often in association with a vagotomy.



- 43 A 56 year old woman who has undergone previous surgery is referred to nuclear medicine for a gastric emptying study. The patient ingests radio-labelled fruit juice, bread and scrambled egg. The gastric emptying curves demonstrate the liquid phase to have a  $T_{1/2}$  of 10 minutes and the solid phase to have a  $T_{1/2}$  of 20 minutes.

**How would you interpret these findings?**

- (a) Normal gastric emptying
- (b) Dumping syndrome
- (c) Gastric stasis
- (d) Previous vagotomy
- (e) Gastric outlet obstruction

**43 (b)**

The  $T_{1/2}$  for both of these phases is abnormally low indicating rapid transit of liquid and solid components; dumping syndrome may be seen following gastric surgery. Normal rates of emptying are  $T_{1/2} < 30$  minutes for liquids, and 30-120 minutes for solid food. Vagotomy leads to rapid gastric emptying and delayed solid emptying. Gastric stasis will result in delayed transit of solid and liquid components.

- 53 A 46 year old man presents with vomiting, epigastric pain, ankle swelling, poor appetite, and weight loss. OGD shows marked enlargement of the proximal rugal folds and ulceration. A subsequent barium follow-through examination shows dilution of barium in the stomach and thickening of folds within the small intestine.

**What is the most likely diagnosis?**

- (a) Carney syndrome
- (b) *Helicobacter pylori* infection
- (c) Ménétrier's disease
- (d) Pernicious anaemia
- (e) VIPoma

**53 (c)**

Ménétrier's disease (giant hypertrophic gastritis) results in marked thickening of the gastric mucosal folds, typically in the proximal half of the stomach. The gastric mucosa secretes copious mucus (dilution of barium), which results in a protein-losing enteropathy (leading to SB fold thickening). There is associated achlorhydria which can lead to ulceration.

**73 A patient undergoing an endoscopic US examination is found to have a lesion within the muscularis propria layer of the stomach wall.**

**What is the most likely diagnosis?**

- (a) Adenocarcinoma
- (b) Lipoma
- (c) Gastro-intestinal stromal tumour
- (d) Peritoneal metastasis
- (e) Varices

**73 (c)**

GIST, leiomyoma and leiomyosarcoma arise in this level.

Adenocarcinoma arises within the mucosa, lipoma within the submucosa and metastases are seen at the serosal surface. Varices may be in the submucosa or extrinsic to the stomach.

5) A 34-year-old woman with a history of steatorrhea and weight loss undergoes a small bowel follow-through examination that demonstrates dilatation of the proximal small bowel with flocculation and segmentation of the barium column. Fold thickness is normal. What is the most likely diagnosis?

- a. Crohn's disease
- b. Zollinger–Ellison syndrome
- c. coeliac disease
- d. small bowel lymphoma
- e. Whipple's disease

5) c. \*\*\*

Coeliac disease is characterized by malabsorption due to intolerance to the alpha-gliadin component of gluten, which causes small intestinal villous atrophy. Typical findings are of dilatation of the proximal small bowel, together with dilution of the barium column due to hypersecretion of fluid. Artefacts such as segmentation (breaking up of the barium column) or flocculation (clumping of disintegrated barium) were traditionally classic features of coeliac disease, but are less often seen nowadays with improved barium suspensions. In Whipple's disease the small bowel is typically non-dilated, and shows moderate fold thickening. Crohn's disease usually causes nodular fold thickening, and predominantly involves the distal small bowel. Zollinger–Ellison syndrome results in dilatation of proximal small bowel due to hypersecretion, but typically causes thickened folds. Small bowel lymphoma is usually associated with fold thickening.

20) A 25-year-old woman presents with cramping abdominal pain and bleeding per rectum. On examination she has mucocutaneous pigmentation of her mucous membranes and face. A small-bowel follow-through examination demonstrates small-bowel intussusception. Which other finding is most likely to be demonstrated?

- a. separation and displacement of small bowel loops
- b. localized outpouching of the antimesenteric border of the distal ileum
- c. generalized irregular fold thickening
- d. multiple filling defects in the small bowel
- e. generalized dilatation of the small bowel

20) d. \*\*\*

Peutz-Jegher syndrome is characterized by multiple benign hamartomatous intestinal polyps and mucocutaneous pigmentation. It is familial in 50% of cases, with an autosomal dominant inheritance, and sporadic in 50%. It is the most common polyposis syndrome to involve the small intestine, and frequently presents with intussusception. Typical findings are of multiple hamartomatous polyps in the small bowel, and less commonly the colon and stomach. Patients are at increased risk of gastrointestinal malignancy, but also of tumours of the pancreas, breast, ovary, endometrium and testis.

27) A 46-year-old man presents with severe abdominal pain. An erect chest radiograph shows free intraperitoneal air below the diaphragm. What is the most likely cause?

- a. perforated anterior wall duodenal ulcer
- b. perforated posterior wall duodenal ulcer
- c. perforated gastric ulcer
- d. perforated appendix
- e. diverticulitis with perforation

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27) a. \*\*\*

The commonest cause of a free intraperitoneal perforation is an anterior wall duodenal ulcer. However, free peritoneal air is only apparent on an erect chest radiograph in 60% of perforated duodenal ulcers. Possible causes include sealing of the perforation, adhesions preventing the gas reaching the subphrenic space or insufficient time being allowed for gas to collect under the diaphragm. Anterior wall gastric ulcers also perforate into the peritoneal cavity but are a less common cause of pneumoperitoneum. Posterior wall duodenal and gastric ulcers perforate into the lesser sac or retroperitoneal region rather than the peritoneal cavity. Perforated appendix and diverticulitis may produce localized collections of extraluminal gas, but pneumoperitoneum is rare.

28) A 20-year-old woman with anorexia nervosa presents with intermittent abdominal pain and vomiting relieved by lying prone. Barium meal examination reveals a vertical band-like narrowing of the third part of the duodenum, with proximal duodenal dilatation and vigorous to-and-fro peristalsis. What is the most likely diagnosis?

- a. duodenal duplication cyst
- b. annular pancreas
- c. Ladd's bands
- d. superior mesenteric artery syndrome
- e. duodenal atresia



28) d. \*\*\*\*

The third part of the duodenum is bounded posteriorly by the aorta, and anteriorly by the root of the mesentery carrying the superior mesenteric artery. In superior mesenteric artery syndrome, the third part of the duodenum is compressed by the superior mesenteric artery, and the angle between it and the aorta narrows to  $10-22^{\circ}$  (normal  $45-65^{\circ}$ ). The condition is associated with severe weight loss, prolonged bedrest (particularly in a body cast), lumbar lordosis and pregnancy. Patients report intermittent abdominal pain and vomiting, relieved by lying prone or in the knee-elbow position. Duodenal atresia causes complete obstruction usually distal to the ampulla of Vater, and presents in neonates with a 'double-bubble' sign on plain abdominal radiograph. Annular pancreas is usually asymptomatic but may present with abdominal pain and vomiting, and barium meal demonstrates narrowing of the second part of the duodenum. Duodenal duplication cysts cause extrinsic compression of the first and second portions of the duodenum. Ladd's bands are congenital peritoneal bands occurring in association with malrotation that may cause obstruction of the second part of the duodenum, but presentation is usually in infants and children.

36) A 67-year-old man presents with abdominal pain, distension and vomiting. Multiple dilated loops of small bowel are seen on plain abdominal radiograph. A contrast-enhanced CT of the abdomen and pelvis is performed, which shows small bowel dilatation to the terminal ileum, where there is a nodular calcified mass with surrounding desmoplastic reaction. What is the most likely cause of small bowel obstruction?

- a. adhesions
- b. carcinoid tumour
- c. Crohn's disease
- d. previous irradiation
- e. small bowel lymphoma

36) b. \*\*\*

The commonest cause of small bowel obstruction in adults is adhesions, which are diagnosed on CT when there is an abrupt calibre transition without an associated mass, surrounding inflammatory changes or bowel wall thickening. Carcinoid tumours comprise 25% of all tumours of the small bowel. They are commonly asymptomatic but may present with pain or obstruction, or with carcinoid syndrome in 7% of patients. Most occur in the ileum, and typical appearances are of a calcified mass with surrounding desmoplastic reaction, retraction of the mesentery and thickening of surrounding loops of bowel. Small bowel obstruction complicates Crohn's disease in approximately 15% of patients, due to thickening and submucosal oedema of the bowel wall. Previous irradiation may result in adhesions and fibrotic changes in the mesentery that can cause bowel obstruction. Lymphomatous involvement of the small bowel causes circumferential bowel wall thickening, but this rarely results in obstruction.

55) A 60-year-old woman presents with weight loss and diarrhoea. CT of the abdomen demonstrates multiple, enlarged, low-attenuation mesenteric lymph nodes containing fat-fluid levels and splenic atrophy. What is the most likely diagnosis?

- a. tuberculosis
- b. coeliac disease
- c. Whipple's disease
- d. lymphoma
- e. metastatic squamous cell carcinoma

55) b. \*\*\*\*

Cavitating mesenteric lymph node syndrome is a rare complication of coeliac disease, in which multiple enlarged lymph nodes are seen in the jejunoileal mesentery. The nodes have central low attenuation and may contain fat or fluid, or fat-fluid levels. Splenic atrophy is usually seen, and jejunal or duodenal biopsy confirms villous atrophy of the small bowel mucosa. Low-attenuation lymphadenopathy may also be seen in tuberculosis, Whipple's disease, lymphoma and necrotic metastases, but fat-fluid levels have been reported only in coeliac disease.



19. A 25 year old male presents with abdominal cramps and pain with rectal bleeding. Colonoscopy is normal. CT enteroclysis is performed as part of the investigation, which reveals multiple sessile polyps throughout the jejunum and ileum. Subsequent biopsies reveal these polyps to be hamartomas. Which one of the following syndromes is he most likely to be diagnosed with?
- a. Peutz-Jeghers
  - b. Cowden's
  - c. Turcot's
  - d. Familial polyposis
  - e. Gardner's

19. a. Peutz-Jeghers

Peutz-Jeghers syndrome is most consistent with these findings. It is an autosomal dominant syndrome but often arises as a spontaneous mutation. Hamartomas are found throughout the gastro-intestinal tract, with the exception of the oesophagus. The polyps have almost no malignant potential, but life expectancy is decreased due to associated cancers arising in the stomach, duodenum, colon and ovary. Gardner's syndrome and familial polyposis are both associated with small bowel adenomas in approximately 5% of cases. Cowden's syndrome does involve hamartomatous polyps, but these are typically rectosigmoid, and small bowel involvement is not a feature. Small bowel polyps are not a feature of Turcot's syndrome.

20. A 17 year old female undergoes screening colonoscopy and is found to have multiple adenomatous polyps throughout the colon. OGD and biopsy reveal multiple hamartomas of the stomach and duodenum. She subsequently has investigation for a painful jaw that reveals a 1 cm round, discrete, dense lesion in the mandible. Which one of the following syndromes is the most likely underlying diagnosis?
- a. Lynch syndrome
  - b. Cronkhite-Canada syndrome
  - c. Familial adenomatous polyposis
  - d. Gardner's syndrome
  - e. Peutz-Jegher syndrome

#### 20. d. Gardner's syndrome

Gardner's syndrome is an autosomal dominant condition with colonic polyps present in all patients. Small bowel, duodenal and stomach polyps are also a feature. Extra-intestinal features include osteomas of membranous bone (typically the mandible as described in the question), other soft-tissue tumours and periampullary carcinomas. Osteomas are not a feature of the other conditions. Cronkhite-Canada syndrome and Peutz-Jegher syndrome are associated with multiple hamartomatous polyps of the colon and stomach. Cronkhite-Canada syndrome is a sporadic non-familial disorder. Lynch syndrome, or hereditary non-polyposis colorectal carcinoma (HNPCC), is associated with increased risk of colorectal adenomas and other malignancies such as endometrial and other gastro-intestinal tract malignancies.

25. A one year old boy is admitted unwell with generalised abdominal tenderness and guarding. A supine plain abdominal film is requested, which shows a large oval radiolucency in the middle of the abdomen, with a well-defined linear opacity in the right upper quadrant. Which one of the following conditions would best explain these appearances?

- a. Enteric duplication cyst
- b. Choledocal cyst
- c. Pneumoperitoneum
- d. Duodenal atresia
- e. Caecal volvulus

#### 25. c. Pneumoperitoneum

Whilst uncommon, the appearances seen on plain film are consistent with massive pneumoperitoneum. The oval radiolucency is called the 'football sign' and arises due to free air collecting anterior to the intra-abdominal viscera. This sign is only seen in 2% of adults with pneumoperitoneum due to the large quantities of air required to produce it. It is much more common in infants who may present at a later stage. The opacity in the right upper quadrant is produced by air outlining the falciform ligament, which again is a sign of pneumoperitoneum. Causes of perforation in this age group include trauma, intussusception and complications of Meckel's diverticulum.

27. A 31 year old male is investigated as an outpatient for diarrhoea. A small bowel meal study reveals jejunal dilatation with thickened valvulae conniventes. In the ileum an increased number of mucosal folds are seen. Which of the following diagnoses is most likely?
- a. Lymphoma
  - b. Crohn's disease
  - c. Coeliac disease
  - d. Whipple disease
  - e. Behcet syndrome

27. c. Coeliac disease

Jejunal dilatation and jejunalisation of the ileal loops are characteristic features of coeliac disease. This is an immunological intolerance to gluten that causes villous atrophy in the small intestine. In Whipple disease there is thickening of the jejunal and duodenal mucosal folds but typically no luminal dilatation. Dilatation of the small bowel does occur with lymphoma but jejunalisation of the ileum is not a feature.

32. A 38 year old patient with AIDS presents with diarrhoea and steatorrhoea. As part of the work-up, small bowel enteroclysis shows thickened jejunal folds with nodularity and evidence of marked jejunal spasm. The ileum has normal appearances. Which one of the following is the most likely underlying cause?
- a. *Cytomegalovirus*
  - b. Tuberculosis
  - c. *Mycobacterium avium intracellulare*
  - d. *Cryptosporidium*
  - e. Giardiasis

32. e. Giardiasis

All the stems are potential causes for these symptoms in a patient with AIDS, however giardiasis is the most likely cause given these imaging appearances. *Cytomegalovirus* most typically affects the caecum, and tuberculosis affects the caecum and ileocaecal valve. *Mycobacterium avium intracellulare* can affect the ileum and jejunum but does not usually cause spasm. *Cryptosporidium* affects the duodenum and the jejunum can be affected, but dilatation is more common than spasm.



35. A 34 year old female is investigated for intermittent abdominal pain and malabsorption. Small bowel meal shows dilatation of the proximal small bowel loops but a normal mucosal fold pattern. Which one of the following is the most likely underlying diagnosis?
- a. Coeliac disease
  - b. Amyloid
  - c. Whipple disease
  - d. Giardiasis
  - e. Eosinophilic gastroenteritis

**35. a. Coeliac disease**

All of these may cause malabsorption. Amyloid can cause dilatation but also causes diffuse thickening of the valvulae conniventes throughout the small bowel. With Whipple disease and eosinophilic gastroenteritis, one would not see dilatation of the bowel, but thickening of the mucosa is again a prominent feature. Giardiasis causes thickening and marked distortion of the mucosal folds in the duodenum and jejunum. One of the hallmark features of untreated coeliac disease is jejunal dilatation. Typically the mucosal folds are of normal thickness.

39. A 45 year old female has a CT for abdominal pain and weight loss. Findings include a soft-tissue mass at the root of the small bowel mesentery with eccentric calcifications and tethering of adjacent small bowel loops resulting in a moderate degree of small bowel obstruction. There is a desmoplastic reaction within the surrounding mesentery. Which one of the following is the most likely diagnosis?
- a. Lymphoma
  - b. Carcinoid tumour
  - c. Melanoma metastases
  - d. Tuberculosis
  - e. Paraganglioma

**39. b. Carcinoid tumour**

These features are typical of carcinoid tumour. The desmoplastic reaction appears on CT as thickened mesentery in a radiating pattern away from the soft-tissue mass, with beading of the mesenteric vascular bundles.

56. An ultrasound of the abdomen is performed on a 21 year old female presenting to A&E with acute right iliac fossa pain, pyrexia, tenderness and guarding. Which one of the following findings would suggest perforation of the appendix?
- a. Appendix diameter of 8 mm
  - b. Appendix wall thickness of 4 mm
  - c. Decreased resistance of arterial waveform
  - d. Loss of visualisation of hyperechoic submucosa
  - e. Increased echogenicity of surrounding fat

**56. d. Loss of visualisation of hyperechoic submucosa**

The use of ultrasound for the diagnosis of acute appendicitis is particularly useful in children and women of child-bearing age. Findings indicating acute appendicitis include a tubular non-compressible blind-ending structure with diameter  $>6$  mm and wall thickness  $>2$  mm, although these signs do not necessarily indicate perforation. **Features suggesting perforation include** a fluid collection adjacent to the appendix, gas bubbles near the appendix and loss of visualisation of the submucosal layer.

59. A 57 year old diet-compliant male patient with coeliac disease has a CT abdomen and pelvis for the investigation of cachexia and two stone weight loss over six months. A 7 cm segment of ileum shows mild dilatation and circumferential thickening, with multiple low-attenuation mesenteric and para-aortic lymph nodes. Which one of the following is the most likely diagnosis?
- a. Tuberculosis
  - b. Gastro-intestinal lymphoma
  - c. Coeliac disease
  - d. Whipple disease
  - e. Crohn's disease

**59. b. Gastro-intestinal lymphoma**

Hypoattenuating lymph nodes can be attributed to many causes, but lymphoma and tuberculosis are the most common. Lymphoma of the gastro-intestinal tract most commonly affects the ileum, although lymphoma associated with coeliac disease most commonly affects the jejunum. Although 90% of tuberculosis of the gastro-intestinal tract occurs in the ileum, lymphoma is most likely in this scenario. Dilatation of the small bowel with lymphoma is common but obstruction is rare due to the soft pliable nature of the tumour.

- 12 A 12-year-old female child presented with intermittent abdominal pain and vomiting over a two-month period with no weight loss. On examination there was voluntary guarding in the central abdomen but no peritonism. Their inflammatory markers were raised. An ultrasound showed a trace of fluid but no structural abnormality. A technetium-99m pertechnetate scan showed uptake in the stomach and right iliac fossa on the 20-minute images. What is the most likely diagnosis?
- a Crohn's disease with multiple sites of activity
  - b Appendicitis
  - c Meckel's diverticulum
  - d Mesenteric adenitis
  - e Right ovarian torsion

12 Answer C: Meckel's diverticulum

Meckel's diverticulum is due to persistence of the omphalomesenteric duct, which normally obliterates in utero. Fifty per cent contain ectopic mucosa, which is usually gastric but may be pancreatic or colonic. This can demonstrate technetium uptake similar to normal stomach mucosa. It is therefore very important that the entire abdomen is imaged on the camera simultaneously to demonstrate simultaneous uptake.

- 20 An 80-year-old man was readmitted to the surgical ward one month after an elective abdominal aortic aneurysm repair complaining of nausea and vomiting. A plain abdominal radiograph demonstrated gaseous distension of the stomach and duodenal bulb. Contrast-enhanced CT did not reveal any further abnormality and a barium meal was performed which showed stricturing of the distal duodenum. What is the most likely explanation for these findings?
- a Adhesions
  - b Annular pancreas
  - c Duodenal haematoma
  - d Infected Dacron vascular graft
  - e Paralytic ileus

20 Answer A: Adhesions

- 23** An eight-month-old female had been crying inconsolably for 12 hours during which time she had passed at least two bloodstained stools. She was admitted to hospital and a plain abdominal radiograph showed a soft mass in the right upper quadrant which corresponded to a fullness of the abdomen on physical examination. An ultrasound was performed which showed a 'pseudokidney' in this region. What is the most likely diagnosis?
- a Ileocolic intussusception
  - b Ileoileocolic intussusception
  - c Mid-gut volvulus
  - d Ileo-ileal intussusception
  - e Pyloric stenosis

**23** Answer A: Ileocolic intussusception

This is a classic age and history for intussusceptions and the most common site type is ileocolic.

- 24** A 51-year-old male was investigated for vague abdominal symptoms including abdominal pain and weight loss. Physical examination revealed generalised peripheral lymphadenopathy and some areas of hyperpigmentation of the skin. A diagnosis of Whipple disease was suspected and a small bowel contrast study was performed. What features would most support this diagnosis?
- a Sand-like nodules (approx 1 mm) in non-dilated small bowel
  - b Small nodules (>2 mm) in non-dilated small bowel
  - c Thick folds in non-dilated small bowel
  - d Normal folds in dilated small bowel
  - e Thick folds in dilated small bowel

**24** Answer A: Sand-like nodules (approximately 1 mm) in non-dilated small bowel

Whipple disease characteristically causes sand-like nodules in a non-dilated small bowel.

- 25 A patient underwent a small bowel follow-through study, which you have been asked to review. The luminal diameter was 2 cm and the valvulae conniventes and wall both measure 1-mm thick. What is the correct conclusion?
- a Crohn's disease
  - b Normal study
  - c Blind loop syndrome
  - d Small bowel obstruction
  - e Small bowel lymphoma

25 Answer B: Normal study

- 26 A young adult male who had recently moved to the UK from India presented with abdominal pain, diarrhoea and weight loss. A CT showed evidence of ileitis. Stool cultures were negative. What feature would favour a diagnosis of tuberculous ileitis rather than Crohn's disease?
- a Aphthous ulcers
  - b Isolated terminal ileal involvement
  - c Small rosethorn ulcers
  - d Thickening of circular small bowel folds
  - e Ulcers with elevated margins following lymphoid follicles

26 Answer E: Ulcers with elevated margins following lymphoid follicles

Gastrointestinal tuberculosis most commonly affects the ileocaecal region and may mimic Crohn's disease. Large shallow, linear, stellate ulcers with margins following the orientation of lymphoid follicles are characteristic.



- 27 A 26-year-old female presented with a long history of abdominal bloating, pale loose stools and weight loss. She underwent a series of investigations including a small bowel enema and eventually, following jejunal biopsy, was diagnosed with coeliac disease (nontropical sprue). What radiographic features are most likely to have been visible on her small bowel enema?
- a Reversal of jejunal and ileal fold patterns
  - b Strictureing lesions
  - c Enteroenteric fistulae
  - d Polypoidal small bowel filling defects
  - e The moulage sign

27 Answer A: Reversal of jejunal and ileal fold patterns

- 70 A 50-year-old woman who had been treated for cervical carcinoma 18 months previously presented with colicky abdominal pain. A CT showed thickening of the ileal wall with luminal narrowing, which was causing partial obstruction. There was also increased attenuation of the associated mesentery. What is the most likely diagnosis?
- a Carcinoid
  - b Crohn's disease
  - c Ischaemic bowel
  - d Lymphoma
  - e Radiation enteritis

70 Answer E: Radiation enteritis

Radiological changes appear up to one to two years after radiation. The ileum is the most common part of the bowel affected. There is often increased attenuation of the mesentery.

- 12 An adult male presented with weight loss and intermittent abdominal pain. A CT demonstrated a small bowel mass and adjacent soft-tissue mesenteric mass with calcification. An In-111 labelled octreotide study was performed with SPECT images which demonstrated uptake in the small bowel and mesenteric mass and further uptake in the liver and lungs. What is the likely diagnosis?
- a Extra adrenal phaeochromocytoma (paraganglioma)
  - b Carcinoid syndrome
  - c Widespread carcinoid metastases
  - d Metastatic gastrointestinal stromal tumour (GIST)
  - e Lymphoma

12 Answer C: Widespread carcinoid metastases

In 111-labelled octreotide study is used to assess for somatostatin receptor positive carcinoid disease and if positive may indicate that the patient's disease is suitable for radiolabelled treatment. Carcinoid syndrome specifically relates to clinical symptoms in the presence of liver or lung metastases but is not a radiological diagnosis. The CT findings are not typical of lymphoma. Paraganglioma is usually assessed with MIBG but does show octreoscan uptake but the radiological findings are not consistent with this diagnosis.

- 21 A patient presented with anaemia and ongoing melaena. Colonoscopy and blood biochemistry results were normal. Red blood cell scintigraphy localised the source of bleeding to the small bowel and an ultrasound of the abdomen showed a well-defined, spherical mass of low reflectivity measuring 5 cm in diameter. What is the most likely diagnosis?
- a Carcinoid
  - b Leiomyoma
  - c Lymphoma
  - d Adenocarcinoma
  - e Tuberculosis

21 Answer B: Leiomyoma

Leiomyoma are the most common benign small bowel tumours and are responsible for half of cases of small bowel haemorrhage. Their usual presentation is with bleeding from the ulcerated tumour surface in the small bowel. Carcinoma is rare in the small bowel. Carcinoids represent 1.5% of all GI neoplasms and most commonly occur in the appendix. Ultrasound may show a broad-based intraluminal mass in the early stages. The small bowel is involved in 30% of lymphoma and usually a mass, either circumferential or extending along the bowel, is visible.

- 22 An otherwise well 19-year-old male was seen in Gastroenterology Outpatients with a long history of diarrhoea and weight loss. He was noted to have mouth ulcers and a few reddened raised areas on his shins. A small bowel follow-through, colonoscopy and further blood tests were arranged. What is the most likely finding on the follow-through?

- a Linear ulcers on mesenteric border
- b Shallow small rounded ulcers
- c Double tracking ulcers
- d Single large (>5 cm) deep ulcer
- e Mass lesion

22 Answer A: Linear ulcers on mesenteric border

Linear ulcers on the mesenteric border are nearly pathognomonic of Crohn's disease. Ulcers are most commonly multiple in inflammatory bowel disease. Double tracking ulcers are usually seen in the colon in the context of ulcerative colitis.

- 23** A 14-year-old boy presented with crampy abdominal pain and a history of darkened stools over the last few weeks. Physical examination was normal other than some vague central abdominal tenderness and pigmentation of the lower lip. An urgent ultrasound showed a probable intussusception. Following reduction a follow-up small bowel study showed multiple broad-based polyps mainly in the jejunum and ileum. What is the most likely diagnosis?
- a Familial adenomatous polyposis
  - b Cowden syndrome
  - c Juvenile polyposis
  - d Cronkhite-Canada syndrome
  - e Peutz-Jeghers syndrome

**23** Answer E: Peutz-Jeghers syndrome

Peutz-Jeghers is a relatively rare autosomal-dominant condition that is characterised by the presence of gastrointestinal polyps and mucocutaneous pigmentation. The polyps are mainly seen in the small bowel and are classically broad based. In the presence of abdominal pain intussusception occurs in up to 47%.

- 25** A previously well 55-year-old male presented with diarrhoea, facial flushing and wheeze. After further investigation he was found to have a carcinoid tumour of the GI tract. What is the most likely site of the primary tumour?
- a Oesophagus
  - b Appendix
  - c Distal ileum
  - d Colon
  - e Rectum

**25** Answer B: Appendix

Commonest sites are appendix (>60%) and small bowel 20% (distal 2 feet of ileum). They are rare in the rectum and stomach and virtually never occur in the oesophagus.

- 27 A patient presented with signs, symptoms and preliminary investigations suggestive of a Meckel's diverticulum. A Tc-99m pertechnetate study was positive and the patient was taken to theatre for a planned resection. At the time of surgery, no Meckel's diverticulum was identified. Other than observer error, what might explain the falsely positive Tc-99m pertechnetate study result?
- a Ileal malrotation
  - b Intussusception
  - c Meckel's perforation
  - d Profuse gastrointestinal haemorrhage
  - e Rapid bowel transit

27 Answer B: Intussusception

There are many causes of false positive Tc-99m pertechnetate studies which include: ectopic gastric mucosa, enteric duplication, Barrett's oesophagus, arteriovenous malformations, haemangiomas, hypervascular tumour, aneurysm, duodenal ulcer, ulcerative colitis, Crohn's disease, appendicitis, intussusception, bowel obstruction and urinary tract obstruction. Ileal rotation, haemorrhage and rapid bowel transit are causes of a false negative study.

- 34 A young patient with Crohn's disease and recurrent episodes of perianal sepsis was found to have an enterocolic fistula. What is the most likely location of this fistula?
- a Ileocolic
  - b Ileocaecal
  - c Ileo-ileal
  - d Colo-coloic
  - e Ileosigmoid

34 Answer B: Ileocaecal

Crohn's disease is the third commonest cause of fistula after iatrogenic and diverticular fistulae. Enterocolic are most often between ileum and caecum; other fistula may occur: enterocutaneous (8–21%), rectum to skin or vagina, peri-anal fistulae and sinus tracts.



- 70 A 34-year-old Indian male was assessed in the Gastroenterology outpatient clinic with a one-year history of weight loss and vague abdominal discomfort. His chest radiograph was of normal appearance and his tuberculin skin test was negative, but he had multiple risk factors for tuberculous disease. Primary intestinal tuberculosis was considered as a possibility and barium studies of the small bowel were arranged which showed disease in the ilea-caecal area. What characteristic would most support tuberculosis as a diagnosis?
- a Cobblestoning
  - b Deep fissures and large shallow linear ulcers with elevated margins
  - c Longitudinal submucosal ulceration over several centimetres
  - d Presence of multiple ulcers that resemble 'rose thorns'
  - e Presence of pseudopolyps

- 70 Answer B: Deep fissures and large shallow linear ulcers with elevated margins

In primary intestinal tuberculosis the classical presentation is with weight loss and abdominal pain and the tuberculin skin test is negative in most patients. The ulcerative form is the most common manifestation and disease is usually seen in the ileocaecal area. Deep fissures and large shallow linear/stellate ulcers with elevated margins are characteristic.

- 3 A 33-year-old woman presented with abdominal pain and distension. A plain abdominal radiograph showed small bowel obstruction and a CT was performed which showed a transition point in a segment of small bowel. What feature would suggest that this is jejunal as opposed to an ileal segment?
- a Sparse/absent valvulae conniventes
  - b More frequent arterial arcades
  - c Thicker valvulae conniventes
  - d Thinner bowel wall
  - e Slightly smaller diameter than rest of small bowel

3 Answer C: Thicker valvulae conniventes

Jejunum	Ileum
3–3.5 cm diameter	2.5 cm diameter
Thicker valvulae conniventes	Thinner valvulae conniventes
1–2 arterial arcades	3–4 arterial arcades
Thicker walls	Thinner walls
Fewer, larger Peyer's patches	More Peyer's patches

- 13 A neonate presented with bile-stained vomiting, which started after its first feed. A plain abdominal radiograph showed a 'double bubble'. The child also had an umbilical hernia, Brushfield spots and a single palmar crease. What is the most likely diagnosis?
- a Annular pancreas
  - b Duodenal atresia
  - c Duodenal stenosis
  - d Ladd bands
  - e Pyloric stenosis

13 Answer B: Duodenal atresia

Duodenal atresia is the most common cause of congenital duodenal obstruction.

Twenty-five per cent of neonates with atresia have Down syndrome as in this case.

- 21 A 55-year-old male who was previously well, presented with a short history of per rectum bleeding and weight loss. Physical examination was normal and a colonoscopy was not available. A contrast-enhanced CT was performed which showed a submucosal vascular lesion in the ileum with associated moderate-volume low-density lymphadenopathy. In addition, in the sigmoid colon, there was an area of irregular but concentric wall thickening consistent with a colonic carcinoma. What is the likely aetiology of each abnormality?
- a Colorectal primary carcinoma with small bowel metastases and lymph node involvement
  - b Carcinoid of the small bowel with large bowel metastases
  - c Small bowel carcinoma with large bowel metastases
  - d Concurrent colorectal and small bowel primary carcinoma
  - e Carcinoid of small bowel with a concurrent colorectal malignancy

21 Answer E: Carcinoid of small bowel with a concurrent colorectal malignancy

Carcinoid tumours are the most common primary tumour of the small bowel

and appendix. One-third of carcinoids are seen in the small bowel and 91% of these are in the ileum. They are classically submucosal vascular lesions and are associated with low-density lymphadenopathy due to necrosis. Approximately 30% have a second primary malignancy of the gastrointestinal tract.

- 22 A 39-year-old male presented with abdominal pain, vomiting and a distended abdomen. A plain abdominal radiograph showed dilated loops of small bowel. He was otherwise well with no previous surgery and his hernial orifices were normal. A contrast-enhanced CT showed an internal encapsulated bowel loop, which was displacing the inferior mesenteric vein. What is the most likely cause for these appearances?
- a Right paraduodenal hernia
  - b Left paraduodenal hernia
  - c Lesser sac hernia
  - d Intersigmoid hernia
  - e Inguinal hernia

22 Answer A: Right paraduodenal hernia

A right paraduodenal hernia is the most common internal hernia and classically displaces the inferior mesenteric vein.

23 A patient presents for review following a CT of their abdomen and pelvis in another centre. The images have not been transferred but the report describes an enhancing submucosal mass in the ileum with associated changes in the mesentery. The report continues describing a stellate radiating pattern and beading of the mesenteric neurovascular bundles with retraction of the mesentery and thickening of the wall of the subtended loops of bowel. Assuming the report is accurate, what is the most likely diagnosis?

- a Lymphoma
- b Metastatic gastric carcinoma
- c Carcinoid tumour
- d Mesenteric panniculitis
- e Gardner's syndrome

23 Answer C: Carcinoid tumour

This is a description of retractile mesenteritis and is associated with all the listed conditions. However, the enhancing submucosal lesion in the ileum is a classic appearance and site of a carcinoid tumour.

24 An 18-year-old girl presented with a one-year history of recurrent colicky abdominal pain, diarrhoea, anorexia and weight loss. Blood tests showed an iron deficiency anaemia. Gastroscopy and colonoscopy as far as the hepatic flexure were normal. A small bowel follow-through showed thickened ileal folds, aphthous ulcers, cobblestoning and terminal ileal stricturing. What is the most likely diagnosis?

- a Crohn's disease
- b Ulcerative colitis
- c Bowel ischaemia
- d Appendicitis
- e Mesenteric venous thrombosis

**24** Answer A: Crohn's disease

The age of presentation of Crohn's disease is typically 15–30 years with an equal sex distribution. The symptoms are often vague and may be present for some time before the diagnosis is made. It can affect any part of the GI tract from the mouth to the anus and can skip segments.

**25** A 28-year-old male presented with abdominal pain and diarrhoea. A CT demonstrated an oedematous terminal ileum with large penetrating ulcers. Further clinical examination revealed stomatitis, genital ulcers and iridocyclitis. What is the most likely diagnosis?

- a Ulcerative colitis
- b Crohn's disease
- c Behcet's syndrome
- d Mirizzi's syndrome
- e Herpes simplex infection

**25** Answer C: Behcet's syndrome

This is a chronic granulomatous inflammatory disease of unknown aetiology. The natural course is relapsing and there is a triad of aphthous stomatitis, genital ulcers and ocular inflammation. Age of onset is the third decade and it affects twice as many males as females.

**26** A 65-year-old woman was investigated for recurrent diarrhoea. Her husband reported that she also became flushed and slightly short of breath after meals. Carcinoid syndrome was suspected and she was referred for an abdominal CT and small bowel MRI study. What feature is most typical of small bowel carcinoid?

- a Duodenal location
- b Calcified lymphadenopathy
- c Mesenteric mass
- d Minimal desmoplastic reaction
- e Free fluid

**26** Answer C: Mesenteric mass



- 27 A 20-year-old woman developed an urticarial rash, flushing, diarrhoea and abdominal discomfort. An abdominal CT demonstrated irregular small bowel fold thickening and a subsequent small bowel contrast study showed multiple tiny small bowel nodules. What is the most likely diagnosis?
- a Amyloidosis
  - b Coeliac disease
  - c Nodular lymphoid hyperplasia
  - d Small bowel carcinoid
  - e Systemic mastocytosis

27 Answer E: Systemic mastocytosis

Causes of tiny small bowel nodules include: nodular lymphoid hyperplasia, lymphoma, amyloidosis, Whipple disease, *Mycobacterium avium-intracellulare*, lymphangiectasia and systemic mastocytosis.

- 63 A young female was admitted with generalised lower abdominal pain. She had a mild pyrexia and borderline raised inflammatory markers. Appendicitis was considered as a diagnosis and an ultrasound was requested. What ultrasound finding would be most supportive of this?
- a Compressible tubular structure >4mm thick
  - b Non-compressible tubular structure >4mm thick
  - c Compressible tubular structure >6mm thick
  - d Non-compressible tubular structure >6mm thick
  - e Wall thickness of 1 mm

63 Answer D: Non-compressible tubular structure >6mm thick

Ultrasound features of appendicitis are total thickness >6mm, non-compressibility, wall thickness >3 mm and a shadowing appendicolith.

- 70 A four-month-old child presented with hyperpigmented wheal and flare skin lesions. An abdominal ultrasound showed hepatosplenomegaly and some enlarged retroperitoneal lymph nodes. Examination of the bowel showed ileal wall thickening and further investigations showed distorted thickened nodular folds in the ileum. What is the most likely diagnosis?
- a Carcinoid
  - b Down syndrome
  - c Mastocytosis
  - d Pheochromocytoma
  - e Trisomy 18

70 Answer C: Mastocytosis

Mastocytosis is a systemic disease where there is mast cell proliferation. Over 50% present before six months old. Urticaria pigmentosa is seen in up to 90% and disease is seen in the skeletal, reticuloendothelial and abdominal systems.

**4. Which of the following is correct regarding carcinoid of the GI tract?**

- A. A minority are asymptomatic when discovered.
- B. The appendix is the most common site of occurrence, representing 33% of all carcinoids.
- C. Over 50% are multiple.
- D. Although malignant change is uncommon in appendiceal carcinoid, as this is the most common site, it accounts for the majority of malignant carcinoids.
- E. The size of the tumour at diagnosis is related to the risk of metastatic spread.

**4. E.** The size of tumour at diagnosis is related to the risk of metastatic spread.

Carcinoid is the 33% tumour, as 33% occur in the small bowel, 33% are multiple, 33% are malignant, and 33% are associated with a second malignancy. Appendiceal carcinoid accounts for 50% of all carcinoids and 67% are asymptomatic at presentation. Appendiceal carcinoid accounts for only 7% of metastatic disease, with small bowel carcinoid causing 75%. The size of the tumour at diagnosis is related to the risk of metastatic spread, which is 2% if the lesion is <1 cm, but 85% if the lesion is over 2 cm in size.

8. A small bowel series is requested for a patient who has a history of systemic sclerosis. Which of the following is a feature of small bowel systemic sclerosis?

- A. Stacked coin appearance due to infiltration of small bowel loops.
- B. Pseudo-diverticula affecting the anti-mesenteric side of the bowel.
- C. Decreased intestinal transit time.
- D. Small bowel systemic sclerosis is only seen in 10% of patients with systemic sclerosis, but the disease is rapidly progressive when it is present.
- ✗ E. Pneumatosis intestinalis.

8. E. Pneumatosis intestinalis.

The stacked coin appearance is seen secondary to intramural haemorrhage—the appearances of systemic sclerosis are of tightly packed folds of normal thickness in a dilated portion of bowel, which has been given the title 'accordion' or 'hidebound' bowel. The pseudo-diverticula (10–40%) are seen on the mesenteric side of the bowel, unlike colonic diverticula. The transit time is prolonged, as there is reduced intestinal motility. Another classical feature is of a markedly dilated duodenum, due to the loss of the enteric innervations—mega duodenum. This classically terminates abruptly at the level of the superior mesenteric artery (SMA). Pneumatosis cystoides can occur in systemic sclerosis of the small bowel. Small bowel disease is seen in up to 40% of patients with systemic sclerosis and indicates rapidly progressing disease.

9. A 26-year-old female presents with a 1-day history of right iliac fossa (RIF) pain. She is mid-cycle and prone to mittelschmerz-type pain, but reports that this pain is more severe than previously. Serum inflammatory markers are elevated. Clinical examination reveals tenderness in the RIF, but no rebound. Due to the compounding gynaecological history, a CT is requested. This reveals a thickened caecum and thickened appendix, which appears to have a defect in the wall on the multiplanar reformatted images. There is a calcified density present in the orifice of the appendix. There is a loculated fluid collection adjacent to the appendix, which has air bubbles within it. There is also fluid in the pelvis. A perforated appendix is removed at surgery. Which of the CT findings is most specific for detecting a perforated appendix?

- A. Presence of a faecolith.
- B. Identification of a wall defect.
- C. Fluid in the pelvis.
- ✗ D. Adjacent abscess formation.
- E. Enlarged regional lymph nodes.



**9. D. Adjacent abscess formation.**

Abscess formation has been found to be the most specific finding in appendiceal perforation, along with extraluminal gas and small bowel ileus. Abscess formation is also one of the least sensitive findings. Regional mesenteric lymph nodes are the most sensitive, but are reasonably non-specific. A focal wall defect, if seen, is reasonably sensitive and specific. Appendicolith is only found in 50% on CT and has a specificity of 70%.

**16. A 68-year-old male patient has a 20-year history of RA. During a recent flare he was commenced on steroid therapy, although this has now been discontinued. The patient is now complaining of mild abdominal discomfort, diarrhoea, and mild weight loss. A barium meal is performed, but is suboptimal, as the patient is poorly mobile. Within the limitations of the study, there is reduced peristalsis in the oesophagus and mild reflux. The antrum of the stomach is felt to be mildly narrowed and rigid. Thickened rugal folds are noted. A subsequent small bowel series is carried out. The jejunal folds measure 4 mm and the ileal folds appear more plentiful and measure 3 mm. Contrast is present in the caecum at 4 hours. Spot screening of the terminal ileum reveals the same findings as those described above. What is the most likely diagnosis?**

- A. Gastric erosions.
- B. Whipple's disease.
- C. Mastocytosis.
- ☒ D. Amyloidosis.
- E. Crohn's disease.

**16. D. Amyloidosis.**

This patient probably has amyloidosis secondary to prolonged RA. GI involvement is more common in primary (70%) than secondary (13%) amyloidosis. Nevertheless, the small bowel is involved in 74% of cases of GI amyloidosis and secondary amyloidosis is the most common type of amyloid disease. Amyloidosis is secondary to the deposition of insoluble amyloid protein in soft tissues and organs. In primary amyloidosis the heart (90%), followed by the small bowel and the lungs (70%), are the most commonly affected organs. The kidneys are affected in 90% of cases

of secondary amyloidosis. Amyloidosis classically causes a diffuse thickening of bowel folds. It may cause dilated bowel folds, if the myenteric plexus is involved. The main differential for amyloid is Whipple's disease and intestinal lymphangiectasia. Whipple's disease does not cause bowel dilatation or rigidity, as described in the antrum in this patient. Crohn's disease can also present with thickened folds, but it is more commonly focal with the most pronounced abnormality in the terminal ileum. Ulceration is also commonly seen in Crohn's, but 68 years old would be a late first presentation for Crohn's. Whilst option A is true, this is not what the question asked. Patients with mastocytosis most commonly present in infancy.

**20. A patient presents to the surgical team with central abdominal pain and vomiting associated with abdominal distension. The abdominal x-ray (AXR) reveals numerous dilated loops of small bowel. A CT scan is carried out. Which of the following statements with regard to CT imaging in small bowel obstruction is accurate?**

- ☒ A. Small bowel mural hyperdensity is a feature and is due to vasodilatation seen in early ischaemia.
- B. Oral contrast is mandatory for the investigation of small bowel obstruction.
- C. Small bowel mural thickening is due to increased venous pressure.
- D. Absence of small bowel mural enhancement is a feature of ischaemic gut secondary to emboli rather than small bowel obstruction.
- E. Lack of small bowel pneumatosis excludes ischaemia of the gut.

**20.A.** Small bowel mural hyperdensity is a feature and is due to vasodilatation seen in early ischaemia.

Multi-detector CT (MDCT) has been found to correlate with pathological processes in small bowel obstruction. The earliest appearance is increased mural density due to hyperaemia. Wall thickening is due to increasing capillary permeability, which causes submucosal oedema. Dilatation is secondary to oedema that limits peristalsis. Lack of enhancement occurs when the bowel dilates and compresses the capillary bed. Pneumatosis is secondary to mucosal ischaemic change, which allows luminal air to track into the wall. Lack of enhancement is also seen in embolic ischaemia, but is not a specific sign of this process. Whilst oral contrast is preferred in many centres, as it can help define if complete obstruction is present, it is not mandatory. Some centres prefer the negative contrast provided by the fluid in the bowel lumen. Patients with small bowel obstruction are also often unable to tolerate oral contrast due to vomiting.



**21. A patient with a history of inflammatory bowel disease, treated with colonic resection and J pouch anastomosis, presents to the surgical team in your hospital. The operation was 3 months ago and the initial post-operative period was unremarkable. His post-operative pouchogram was reported as normal and he underwent a reversal of his defunctioning ileostomy 6 weeks ago. He now presents with central and lower abdominal pain associated with nausea and vomiting, but no diarrhoea. The surgeons request a pouchogram, which shows a small blind ending lumen at the superior aspect of the pouch. A follow-up CT scan shows dilated small bowel with a transition point in the ileum, beyond which the bowel is non-distended. The J pouch has mild inflammatory change in the surrounding fat. There is also a small amount of free fluid in the pelvis. The wall of the pouch is not thickened. What is the most likely diagnosis?**

- ☒ A. Small bowel obstruction, as can occur in up to 30% of these patients.  
B. Pouchitis.  
C. Pouch fistula.  
D. Recurrence of Crohn's in the pouch and affected segment of bowel.  
E. Pouch leak.

**21.A.** Small bowel obstruction, as can occur in up to 30% of these patients.

Total colonic resection with J pouch anastomosis is carried out in patients with ulcerative colitis or familial adenomatous polyposis (FAP) in order to resect the entire colon, but retain anal defaecation. One of the main contraindications to total colectomy and J pouch formation is Crohn's disease and such a procedure is uncommonly carried out in this situation due to the high recurrence rate. Pouchitis and small bowel obstruction both occur in up to 30% of patients who undergo this procedure. The radiological features of pouchitis are non-specific, but include wall thickening and increased enhancement of the bowel wall, with peripouch fat-stranding. Fat-stranding on its own is common as a result of both the surgery and possible inflammatory change due to previous proctitis. Small bowel obstruction most commonly occurs in the region of the ileostomy. Free fluid is often seen in small bowel obstruction. The absence of fluid cavities or air pockets is against a leak from the pouch anastomosis and the clinical features are not consistent with fistula. The blind ending lumen described is the normal appearance seen on a pouchogram.

22. A 35-year-old male patient from the Indian subcontinent presents with a 2-month history of lower abdominal pain, per rectum (PR) bleeding, and weight loss. His haemoglobin is 9.4 and C-reactive protein (CRP) is 123. The patient is tender in the RIF. A CT scan is performed due to the suspicion of appendiceal pathology, but with unusual history. This shows bowel wall thickening of the terminal ileum with mild proximal bowel dilatation. The inner bowel wall is hypodense with enhancement of the outer bowel wall. There is stranding in the fat, which causes a mass effect displacing other loops of bowel. Mild regional adenopathy is noted. The appendix is not visualized, but the caecum appears normal. There is a similar area of bowel wall thickening in the sigmoid colon. What is the most likely diagnosis?

- A. Yersinia.
- B. Tuberculosis.
- C. Lymphoma.
- D. Crohn's disease.
- E. Carcinoid.

**22. D. Crohn's disease.**

The findings described are classical for Crohn's disease and lymphadenopathy is seen in up to 30% of cases. Tuberculosis more typically involves the caecum. Lymphoma usually causes a nodular appearance to the bowel. It is not associated with stricturing of the affected segment and is more classically associated with dilatation of the affected segment due to destruction of the myenteric plexus.

**34. A patient presents to A&E with severe upper abdominal pain 4 days following a barium enema. There is no free air under the diaphragm on the erect CXR. There is mild elevation of the inflammatory markers, but the surgeon is concerned with the degree of peritonism and requests a CT scan of abdomen. On this, the small bowel is dilated to 5 cm, but is not thick walled. The vascular structures enhance normally. There is inflammatory change noted around the duodenum. Linear areas of low attenuation are noted extending from the porta hepatis into the liver parenchyma. These do not extend to the margin of the liver and are in general central in their location. The Hounsfield attenuation value of these areas is approximately -1500 HU. Barium in the rectum obscures the images of the pelvis. What is the most likely pathology?**

- A. Cholecystoduodenal fistula.
- B. Mesenteric infarction.
- C. Acute bowel obstruction.
- D. Perforated duodenal ulcer.
- E. Complication of barium enema.

**34.A.** Cholecystoduodenal fistula.

The other answers are all causes of portal air, whereas the salient description is for air in the biliary tree.

**53. A 41-year-old female with a background of arthralgia, chronic abdominal pain, and diarrhoea is investigated via a small bowel series. Findings include a prolonged transit time, and dilated loops of small bowel with normal appearing valvulae and pseudodiverticula. What is the most likely diagnosis?**

- A. GI scleroderma.
- B. Behcet's disease.
- C. Whipple disease. *Thickened jejunal folds are seen but no or little dilatation*
- D. Small bowel lymphoma. *Thickened valvulae*
- E. Coeliac disease. *No pseudodiverticulae*

**53.A.** GI scleroderma.

Deeply penetrating ulcers are seen in Behcet's disease. Whipple disease is an extremely rare form of intestinal lipodystrophy. Thickening of jejunal folds is seen, but there is little or no small bowel dilatation and small bowel transit time is normal. Pseudodiverticula are not seen in coeliac disease. The valvulae are thickened in lymphoma.



**58. A 45-year-old man, with a history of AIDS, has a 3-month history of abdominal pain and weight loss. A CT scan of abdomen is performed which shows ascites with peritoneal thickening, several areas of mural thickening in the small bowel, and multiple low attenuation lymph nodes. Which one of the following infections is most likely?**

- A. CMV infection.
- ☒ B. TB.
- C. Cryptosporidiosis.
- D. Amoebiasis.
- E. Campylobacter.

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**58. B. TB.**

Cryptosporidiosis is the most common cause of enteritis in AIDS patients. It more commonly causes proximal small bowel thickening in the duodenum and jejunum, and CT may show small lymph nodes. CMV infection of the small bowel can show a terminal ileitis indistinguishable from Crohn's disease. The typical CT findings in amoebiasis are thickening of the right colonic wall and a rounded abscess in the right lobe of liver with a peripheral zone of oedema. TB usually shows ileocaecal involvement, low attenuation mesenteric nodes, and ascites with peritoneal thickening. Mycobacterium avium intracellulare may also occur with low attenuation mesenteric nodes and thickening of small bowel folds.

**59. A 44-year-old man presents with a vague history of central abdominal pain and mild weight loss. On further questioning, there are other features in the history suggestive of malabsorption. Amongst other investigations, a CT scan of abdomen is requested. This shows dilated fluid-filled small bowel loops and multiple enlarged mesenteric lymph nodes, encasing the mesenteric vessels. The lymph nodes are of homogeneous soft tissue density. What is the most likely cause of the CT findings?**

- A. Whipples disease.
- B. Coeliac disease complicated by lymphoma.
- C. Cavitating mesenteric lymph node syndrome.
- D. Abdominal tuberculosis.
- E. Castleman disease.

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**59. B.** Coeliac disease complicated by lymphoma.

Whipples disease, cavitating mesenteric lymph node syndrome, and abdominal TB more typically have mesenteric lymph node enlargement that has central low attenuation, rather than being of homogeneous soft-tissue density. Whipple disease is a systemic bacterial infection caused by *Tropheryma whippelii*. Lymph nodes affected by Whipple disease typically have a high fat content, causing the low attenuation, usually between 10 and 20 HU.

Cavitating mesenteric lymph node syndrome is associated with coeliac disease. The lymph nodes are truly cavitating and usually regress following a gluten-free diet.

The lymph nodes in abdominal tuberculosis typically have caseous necrosis and thus central low density on CT.

Castleman disease causes benign masses of lymphoid tissue of unknown aetiology. It can cause mesenteric lymphadenopathy, which is homogeneous, but the disease itself is rare and mesenteric involvement is much less common than mediastinal involvement.

**66. A 55-year-old woman is admitted to hospital after several episodes of melaena. She has an upper GI endoscopy performed, which is normal. A CT scan of abdomen is requested and this demonstrates a large exophytic mass arising from the jejunum in the left upper quadrant. It is heterogeneous in density, and has some peripheral enhancement and central necrosis. There is no calcification, intestinal obstruction, or evidence of aneurysmal dilatation of the affected segment of jejunum. There is no adjacent lymphadenopathy or ascites. What is the most likely diagnosis?**

A. Adenocarcinoma.

B. Lymphoma.

C. Carcinoid tumour.

D. Metastasis.

☒ E. Gastrointestinal stromal tumour (GIST).



**66. E. Gastrointestinal stromal tumour (GIST).**

At contrast-enhanced CT, GISTs appear as large exophytic masses with peripheral enhancement. They usually have an attenuation similar to that of muscle, but they may have heterogeneous attenuation, depending on their level of aggressiveness. More aggressive GISTs may also contain a central area of necrosis.

Adenocarcinoma of the jejunum is rare, more commonly occurring in the duodenum. They also tend to be stricturing lesions, rather than exophytic masses and may present with obstruction.

Carcinoid is also rare in the proximal small bowel, the distal ileum being a more usual location. The primary lesion is often quite small, with the nodal metastatic lesion in the small bowel mesentery being more conspicuous on CT. This is often spiculated (surrounding desmoplastic reaction) and may contain calcification.

Lymphoma can have a number of manifestations in the small bowel, from nodular thickening of the mucosal folds to large masses with aneurysmal dilatation of the small bowel in the affected segment. Associated lymphadenopathy is typical.

**72. A 45-year-old man has a long history of intermittent diarrhoea, abdominal bloating, and cramps, but has neglected to seek medical advice until now. His GP is worried about undiagnosed Crohn's disease and sends him for a small bowel series. This shows some dilatation of the proximal small bowel, with segmentation and flocculation of the barium and an increased number of normal thickness folds seen in the ileum. There is no evidence of stricture formation or ulceration. What is the most likely underlying diagnosis?**

- A. Amyloidosis.
- B. Chronic ischaemic enteritis.
- C. Whipple's disease.
- D. Coeliac disease.
- E. Lymphoma.

**72. D. Coeliac disease.**

The segmentation and flocculation of barium are findings on a small bowel series that are typical of malabsorption and therefore the most likely diagnosis is coeliac disease. Other findings in coeliac disease include dilatation, a granular appearance to the barium secondary to hypersecretion, jejunization of the ileum, and the 'moulage' sign. The latter refers to a smooth, tubular appearance to the jejunum in longstanding coeliac disease, secondary to atrophy and effacement of the jejunal mucosal folds.

Lymphoma can be a complication of coeliac disease and generally causes shallow, ulcerated masses or the development of thickened, nodular small bowel folds.

Whipple's disease, amyloidosis, and chronic ischaemic enteritis all cause thickening of the small bowel folds.

**73. A 40-year-old male with a 22-year history of Crohn's disease presents with abdominal pain, diarrhoea, and low-grade fever. To attempt to limit his lifetime radiation exposure he is investigated via MR enterography. Which of the following MRI findings is considered to be the earliest in active inflammation?**

- A. Increased mesenteric vascularity.
- B. Small bowel wall thickening.
- C. Mucosal hyperenhancement.
- D. Perienteric inflammation.
- E. Reactive adenopathy.

**73. C. Mucosal hyperenhancement.**

The lack of ionizing radiation is a major advantage to MRI for patients with Crohn's disease given the chronic nature of this condition necessitating frequent investigation. MRI can be performed via enterography or enteroclysis. In enterography, large volumes of fluid (or a fluid-inducing laxative) are ingested. Enteroclysis involves administration of enteric contrast material via a nasoenteric tube. Sequence acquisition involves fat suppression and intravenous contrast. Increased mucosal hyperenhancement (compared with that seen in normal surrounding loops) may be the earliest sign of active inflammation, even in the absence of wall thickening. Increased vascularity, perienteric inflammation, and reactive adenopathy are other signs of active Crohn's disease. In severe Crohn's disease mucosal hyperenhancement combined with submucosal oedema gives a 'stratified' appearance. Serosal hyperenhancement may also be seen, giving a 'target' appearance. Mural thickening is defined as greater than 3mm, although an underdistended bowel may mimic this finding.

**7) Enteropathy-associated T-cell lymphoma is most commonly associated with which of the following conditions?**

- (a) Coeliac disease
- (b) Crohn's disease
- (c) Lymphangectasia
- (d) Whipple's disease
- (e) Peutz-Jegher's syndrome

7 (a)

This is invariably seen in the underlying bowel in patients with this condition, although it may not have been diagnosed prior to the lymphoma. The other conditions do not predispose to lymphomas.

9 With regard to radiation enteropathy, which of the following is not true?

- (a) Acute changes occur in patients who have received 1,000cGy or more
- (b) Acute changes are due to damage to the blood supply
- (c) Chronic changes may be seen in up to 15% of patients
- (d) Multiple stenoses are a feature of chronic disease
- (e) Acute radiation enteropathy refers to changes within the first 2 months

9 (b)

Acute radiation enteropathy is due to death of the mucosal cells which are dividing rapidly. Chronic enteropathy is due to the effect on the vasculature, resulting in strictures, adhesions and fistulae.

22 A 45 year old woman with a history of diarrhoea and weight loss undergoes an endoscopy and has a duodenal biopsy. The biopsy is reported to show foamy macrophages. Granules within the cytoplasm of these macrophages stain positively with periodic acid-Schiff (PAS) stain.

**What additional feature might you expect on a small bowel enema in this patient?**

- (a) Multiple polyps
- (b) Ulceration of the mucosa
- (c) Reduced mucosal folds with dilatation of the small bowel
- (d) Pseudosacculation
- (e) Thickening of the mucosal folds

**22 (e)**

These are the clinical, pathological and radiological features of Whipple's disease. This is an uncommon condition of the small bowel caused by a bacterial infection, thought to be *Tropheryma whippelli*. Antibiotic therapy needs to continue for at least a year and relapses may involve the CNS.

**34 Which of the following tumours of the vermiform appendix is encountered most commonly?**

- (a) Adenocarcinoma
- (b) Carcinoid
- (c) Lymphoma
- (d) Mucinous adenocarcinoma
- (e) Gastrointestinal Stromal Tumour

**34 (b)**

Seen in up to 1.4% of histology specimens and is usually incidental. Other tumours are encountered less commonly. The presence of adenocarcinoma may necessitate a formal right hemicolectomy to resect the draining lymph nodes.

**47 A 56 year old patient presents with carcinoid syndrome and is found to have liver metastases.**

**What is the most likely site of the primary lesion?**

- (a) Stomach
- (b) Duodenum
- (c) Small Bowel
- (d) Appendix
- (e) Rectum



**47 (c)**

Over 40% of carcinoid tumours arise within the small intestine, with rectum (27%), appendix (24%) and stomach (8%) next most common. Duodenal carcinoids are rare. Small intestinal carcinoid tumours are often symptomatic.

**49 A patient with known Crohn's disease is referred for a small bowel enema.**

**Which of the following features would you not expect to see?**

- (a) Aphthoid ulcers
- (b) Kinked bowel segments
- (c) Sacculation
- (d) Increased number of folds in the ileum
- (e) Loop separation

**49 (d)**

Jejunisation of the ileum is a feature of coeliac disease. In addition to the other features, transmural ulceration, fistulae, stenoses and fold thickening may be seen. Crohn's disease may affect any part of the GI tract, from mouth to anus.

**50 A 76 year old man with a clinical suspicion of a hernia is referred for an ultrasound. A colleague performs the study and reports: "The hernia lies lateral to the conjoint tendon and medial to the inferior epigastric artery at the inferior aspect of Hesselbach's triangle."**

**What type of hernia is described?**

- ✓(a) Direct inguinal hernia
- (b) Spigelian hernia
- (c) Hypogastric hernia
- (d) Femoral hernia
- ✓(e) Obturator hernia



**50 (a)**

Direct inguinal hernias originate infero-medial to the inferior epigastric artery, whilst indirect originate supero-laterally. Spigelian hernias lie at the linea semilunaris, hypogastric hernias lie in the midline below the umbilicus and femoral hernias pass through the femoral canal.

- 9 A 57 year old man presents with diarrhoea and is noted to have elevated ACTH levels. A small bowel enema demonstrates no ulceration or strictures but there is sharp angulation of loops of distal ileum.**

**What is the most likely diagnosis?**

- (a) Cushing's disease
- (b) Cushing's syndrome
- (c) Crohn's disease
- (d) Desmoid tumour
- (e) Carcinoid

**9 (e)**

Carcinoid syndrome commonly presents with non-specific symptoms, with obstruction, bleeding pain or diarrhoea all seen. A polypoid nodule may be seen in the wall of the bowel but the desmoplastic reaction in the adjacent mesentery causes sharp angulation of bowel loops.

- 10 Which of the following polyposis syndromes is not associated with malignancy?**

- (a) Gardner's syndrome
- (b) Cronkhite Canada syndrome
- (c) Turcot's syndrome
- (d) Cowden's disease
- (e) Peutz-Jegher's disease

**10 (b)**

Cronkhite Canada syndrome is a rare non-familial condition with multiple hamartomatous polyps resulting in a protein-losing enteropathy. It is seen most commonly in Japan and the underlying cause remains unclear.

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**15 What is the most common site for actinomyces infection within the abdomen?**

- (a) Appendix
- (b) Liver
- (c) Spleen
- (d) Terminal Ileum
- (e) Jejunum

**15 (a)**

Caused by *Actinomyces israelii*, this is a rare condition which clinically mimics an appendix abscess. Sinus tracks, fistulae and a mass may all be seen at imaging. Risk factors include previous abdominal surgery, GI perforation, diabetes mellitus and steroid therapy.

**23 In the assessment of small bowel disease, for which of the following criteria is MRI superior to other imaging modalities?**

- (a) Shorter imaging time
  - (b) Better depiction of early disease
  - (c) Superior spatial resolution
  - (d) Better mucosal detail
  - (e) Superior tissue contrast
-

**23 (e)**

Small bowel enema has the best resolution and better depicts early disease. CT is the fastest study to perform. MRI has superior tissue contrast.

**30 You are asked to supervise a CT enterography study for inflammatory bowel disease which has been protocolled for a single 'enteric phase'.**

**Approximately how long after the commencement of the *i.v.* injection of contrast medium should the study be acquired?**

- (a) 20 secs
- (b) 45 secs
- (c) 70 secs
- (d) 100 secs
- (e) 180 secs

**30 (b)**

This optimises mural enhancement. By contrast, in the evaluation of small bowel neoplasia or obscure GI bleeding, an unenhanced, arterial and portal venous study are usually used. Neutral oral contrast agents are usually favoured, although positive agents may have a role when intravenous contrast medium is contraindicated.

**34 A 53 year old lady undergoes a small bowel enema study. This shows delayed transit with a marked increase in the number of mucosal folds.**

**What is the most likely diagnosis?**

- (a) Systemic sclerosis
- (b) Whipple's disease
- (c) Intestinal lymphangectasia
- (d) Eosinophilic gastroenteritis
- (e) Mastocytosis

**34 (a)**

The 'wire-sprung' or 'hidebound' appearances are characteristic. Dilatation of the duodenum and jejunum, decreased peristalsis and sacculations (pseudodiverticulae) are also features. The remaining conditions cause a non-specific thickening of the mucosal folds.

**35 Which of the following primary tumours is least likely to metastasize to the small bowel?**

- (a) Bronchus
- (b) Thyroid
- (c) Melanoma
- (d) Renal cell carcinoma
- (e) Breast

**35 (b)**

The remaining are the commonest tumours to have blood-borne metastases to the small bowel. Direct invasion may be seen from the prostate, uterus, ovary, colon or kidney; lymphatic spread is less common but may be seen from caecum to terminal ileum.

**37 Which of the following imaging features is more suggestive of a diagnosis of Ulcerative colitis rather than Crohn's colitis?**

- (a) Multiple anal fistulae
- (b) Aphthoid ulceration
- (c) Enlarged lymph nodes
- (d) Entero-enteric fistulae
- (e) Granularity

**37 (e)**

The granular appearance on barium enema is typical. UC is typically contiguous from the rectum and appears symmetrical. In chronic disease, fibro-fatty proliferation is seen in the mesorectum and there is submucosal fat deposition.

**47 A 32 year old man with weight loss is referred for a barium follow through. This is reported to show mild jejunal dilatation. There is a reduction in the number of jejunal folds, an increase in the ileal folds, but only very slight fold thickening.**

**What is the most likely diagnosis?**

- (a) Whipple's disease
- (b) Coeliac disease
- (c) Eosinophilic enteritis
- (d) Scleroderma
- (e) Lymphangectasia

**47 (b)**

This appearance, known as jejunisation of the ileum, is typical of coeliac disease. There is an associated increase in the frequency of both epithelial tumours and NHL in patients with coeliac disease.

**48 Amyloid deposition in the smooth muscle of the small bowel would most likely present with which of the following?**

- (a) Pseudo-obstruction
- (b) Volvulus
- (c) Bleeding
- (d) Pain
- (e) Watery diarrhoea



**48 (a)**

Pain, bleeding or diarrhoea might be seen with deposition in the bowel wall. Volvulus is not a feature of amyloidosis. Both primary and secondary amyloidosis may affect the bowel, as well as other organs.

**49 A 56 year old lady with upper abdominal pain is referred for a CT of the abdomen and pelvis. This shows an abnormal loop of small bowel passing between the portal vein and IVC.**

**What type of internal hernia is this?**

- (a) Foramen of Winslow
- (b) Left paraduodenal
- (c) Transmesenteric
- (d) Right paraduodenal
- (e) Inter-sigmoid

**49 (a)**

The loop of bowel passes through the foramen of Winslow in to the lesser sac. Left paraduodenal hernias pass through a defect in the descending mesocolon and lie to the left of the 4th part of the duodenum; the rarer right paraduodenal hernia passes behind the SMA and is associated with malrotation. Transmesenteric hernias are commoner following surgery.

**51 What is the most common cause for small bowel intussusception in adults?**

- (a) Meckel's diverticulum
- (b) Lymphoma
- (c) Crohn's disease
- (d) Gastrointestinal stromal tumour
- (e) Polypoid tumour

**51 (e)**

Polypoid tumours are the most common cause for small bowel intussusceptions in adults and these may have one of a number of histopathological diagnoses. Crohn's disease does not cause an intussusception but the other conditions can on occasion.

- 56 A 67 year old man presents with abdominal pain, weight loss, fever and diarrhoea. The small bowel enema demonstrates discrete ulcers, both circumferential and longitudinal, with mucosal fold thickening.**

**Which of the following conditions is most likely?**

- (a) Actinomycosis
- (b) Tuberculosis
- (c) Giardiasis
- (d) Yersiniosis
- (e) Strongyloidiasis

**56 (b)**

Lesions are often multiple, and stricture formation is also commonly seen. When the terminal ileum is involved, a rigid and gaping ileocaecal valve may be seen. Cross-sectional imaging may show low attenuation lymph nodes (due to caseous liquefaction), ascites and peritoneal nodules.

- 62 A pregnant lady presents with severe right iliac fossa pain. The surgical team request an MRI to evaluate the appendix.**

**What imaging sequence is best for depicting the appendix?**

- (a) T1
- (b) T2
- (c) STIR
- (d) FLAIR
- (e) DWI

**62 (b)**

T2 weighted images best depict the appendix, but a STIR sequence is sensitive for identifying an inflamed and oedematous appendix. MRI has a sensitivity, specificity and accuracy of over 90% for the diagnosis of acute appendicitis.

**67 A 78 year old lady presents to A&E with small bowel obstruction. A CT study demonstrates the transition point to be a loop of small bowel lying immediately behind the pectineus muscle.**

**What is the diagnosis?**

- (a) Perineal hernia
- (b) Sciatic hernia
- (c) Inferior lumbar triangle hernia
- (d) Femoral hernia
- (e) Obturator hernia

**67 (e)**

The pectineus muscle is the anterior border of the obturator canal, with the obturator externus the posterior margin. Bowel is commonly obstructed with this type of hernia, often seen in elderly patients.

**68 Which of the following extra-intestinal manifestations of inflammatory bowel disease is seen more commonly with ulcerative colitis rather than Crohn's disease?**

- (a) Iritis
- (b) Gallstones
- (c) Sacroiliitis
- (d) Nephrolithiasis
- (e) Erythema nodosum

**68 (c)**

Crohn's disease is more commonly associated with a peripheral, migratory, non-deforming seronegative arthropathy.

- 6) A 44-year-old man undergoes ultrasound of the abdomen during which the liver is incidentally noted to be of diffusely increased echogenicity, with attenuation of the ultrasound beam and poor visualization of the intrahepatic architecture. Which of the following imaging features is most likely in this condition?
- a. liver echogenicity less than that of renal cortex on ultrasound scan
  - b. relatively hypoattenuated intrahepatic vessels on unenhanced CT
  - c. liver attenuation 10 HU greater than that of the spleen on unenhanced CT
  - d. absolute liver attenuation of  $>40$  HU on contrast-enhanced CT
  - e. loss of liver signal intensity on out-of-phase gradient echo MR images

6) e. \*\*\*

Fatty liver describes a spectrum of conditions characterized by triglyceride accumulation within hepatocytes. It is common, affecting around 15% of the general population, but is more prevalent among those with obesity, hyperlipidaemia and high alcohol consumption. Fatty liver may be diagnosed on ultrasound scan if liver echogenicity exceeds that of renal cortex, with attenuation of the ultrasound beam, loss of definition of the diaphragm and poor visualization of the intrahepatic architecture. CT features include absolute attenuation of less than 40 HU on contrast-enhanced CT and, on unenhanced CT, liver attenuation at least 10 HU less than that of spleen, and relatively hyperattenuating liver vasculature. Chemical shift gradient echo imaging is the most widely used MR technique for assessment of fatty liver, demonstrating signal intensity loss on out-of-phase images compared with in-phase images.



16) A previously well, 28-year-old man recently returned from the Far East becomes acutely unwell with fever and right upper quadrant pain. Ultrasound scan demonstrates a well-defined, rounded, 7 cm hypoechoic lesion in the right lobe of the liver contiguous with the liver capsule, with fine homogeneous, low-level internal echoes and acoustic enhancement. What is the most likely diagnosis?

- a. pyogenic abscess
- b. amoebic abscess
- c. fungal abscess
- d. hydatid disease
- e. incidental simple hepatic cyst

16) b. \*\*\*

Pyogenic abscesses are the commonest type of liver abscess in developed countries, and are most frequently due to ascending cholangitis from benign or malignant obstructive biliary disease. They are often poorly defined with irregular walls on ultrasound scan, and may contain debris or demonstrate intense hyperechogenicity when containing gas. Amoebic abscesses tend to occur in younger, more acutely unwell patients from high prevalence areas or with a history of recent travel. They are treated medically whereas pyogenic abscesses usually require percutaneous or surgical drainage. Fungal abscesses are usually multiple and occur in immunosuppressed individuals. Hydatid disease tends to be asymptomatic or present with biliary colic. Characteristic ultrasound scan features include daughter cysts and detachment of the endocyst, giving rise to 'floating membranes' within the cyst cavity.

25) A 43-year-old woman is incidentally found to have a well-defined, rounded, low-density, 2 cm lesion in the liver on unenhanced CT. Contrast-enhanced CT demonstrates peripheral nodular arterial enhancement with complete fill-in on delayed images. What is the most likely diagnosis?

- a. hepatic haemangioma
- b. hepatocellular carcinoma
- c. simple hepatic cyst
- d. focal fatty infiltration
- e. focal nodular hyperplasia

25) a. \*\*\*

Haemangiomas are the most common benign liver tumour. They are often asymptomatic but may present with hepatomegaly or rarely spontaneous haemorrhage. Typical CT features of a hepatic haemangioma are of a well-defined hypodense mass on unenhanced CT, with early peripheral enhancement after intravenous contrast followed by complete fill-in on delayed images. Hepatocellular carcinoma is seen as a hypodense mass and usually demonstrates contrast enhancement during the arterial phase, but enhancement decreases on delayed images. Focal fatty infiltration usually has a geographic distribution, and, like simple hepatic cysts, does not demonstrate contrast enhancement. Focal nodular hyperplasia is usually isodense on unenhanced CT and, although it tends to show intense transient arterial phase enhancement, is often isodense during the portal phase. A central scar, if present, may demonstrate enhancement on delayed images.

- 30) A 68-year-old man presents with acute abdominal pain. As well as other pathology, CT of the abdomen reveals multiple linear branching structures with an attenuation value of  $-1000$  HU in the liver extending to the periphery. What are these appearances most likely to represent?
- a. gas in the portal venous system
  - b. gas in the biliary tree
  - c. portal venous thrombosis
  - d. intrahepatic biliary dilatation
  - e. fatty infiltration of the liver

30) a. \*\*\*

**Portal venous gas** is identified on CT as linear branching structures of air density extending to the periphery of the liver, presumably due to the direction of portal venous flow. The **commonest cause in adults** is mesenteric infarction, when it is a poor prognostic sign. In infants the **commonest cause** is necrotizing enterocolitis, when it does not necessarily imply a poor outcome. **In contrast, gas within the biliary tree**

**is central and does not extend into the peripheral 2 cm of the liver.** In portal venous thrombosis, a focal hypodensity is seen within the portal vein on contrast-enhanced CT. Intrahepatic biliary dilatation appears as dilated branching ductal structures of fluid density. In fatty infiltration of the liver, vessels may appear hyperattenuating on unenhanced CT in contrast to the hypodense liver.



- 38) A 30-year-old woman on the oral contraceptive pill undergoes unenhanced CT of the abdomen, which demonstrates a well-circumscribed, slightly hypoattenuating mass in the liver. Which additional radiological finding would favour a diagnosis of hepatic adenoma rather than focal nodular hyperplasia?
- a. measured lesion size of 3 cm
  - b. accompanying acute subcapsular haematoma
  - c. transient arterial-phase enhancement
  - d. normal uptake on  $^{99m}\text{Tc}$ -labelled sulphur colloid scan
  - e. hypodense central stellate scar

38) b. \*\*\*\*\*

**Focal nodular hyperplasia (FNH)** is a benign hamartomatous malformation commonest in young women. Lesions are usually smaller than 5 cm, and contain a central stellate scar in up to one-third of cases. **Hepatic adenomas** are benign tumours averaging 8–10 cm in size, seen predominantly in young women and related to oral contraceptive use. Lesions have a propensity for spontaneous haemorrhage, presenting as subcapsular haematoma or haemoperitoneum. FNH, though highly vascular, rarely undergoes spontaneous haemorrhage. FNH usually contains sufficient functioning Kupffer cells to demonstrate normal or increased uptake on  $^{99m}\text{Tc}$ -labelled sulphur colloid scan, whereas hepatic adenoma, composed of hepatocytes and non-functioning Kupffer cells, appears as a focal photopenic lesion. Both lesions

demonstrate transient arterial enhancement following intravenous contrast.

- 39) A 25-year-old man presents with jaundice and malaise. Ultrasound scan demonstrates a general decrease in liver echogenicity and a well-distended gallbladder with a wall thickness of 4 mm. No gallstones are seen and the intra- and extrahepatic bile ducts appear normal. What is the most likely diagnosis?
- a. acute cholecystitis
  - b. cirrhosis
  - c. fatty liver
  - d. acute viral hepatitis
  - e. primary sclerosing cholangitis

39) d. \*\*\*

Acute hepatitis results in a diffuse decrease in liver echogenicity on ultrasound scan, with increased brightness of the portal triads resulting in a 'starry sky' appearance. Other imaging features include oedema of the gallbladder fossa and gallbladder wall thickening. Gallbladder wall thickening (anterior wall thickness  $> 3$  mm in a non-contracted gallbladder) may be seen in a wide range of intrinsic and extrinsic conditions. The commonest intrinsic cause is cholecystitis (acute and chronic), whereas common extrinsic causes include hepatitis, hypoalbuminaemia, heart failure and renal failure.

- 44) A 45-year-old patient with cirrhosis is found to have a focal liver lesion on ultrasound scan, clinically suspected to be hepatocellular carcinoma. What would be the expected appearances of the lesion on T2W MR images following infusion of superparamagnetic iron oxide particles?
- a. Increased signal intensity compared with rest of liver
  - b. decreased signal intensity compared with rest of liver
  - c. lesion signal intensity unchanged; rest of liver increased signal intensity
  - d. lesion signal intensity unchanged; rest of liver decreased signal intensity
  - e. no effect on appearances on T2W images



44) d. \*\*\*\*

Superparamagnetic iron oxide (SPIO) particles are iron-based particles of 30–150 nm, which, when administered as an infusion 1–4 hours prior to imaging, act as a negative MR contrast agent. They target the reticuloendothelial system, being taken up by macrophages throughout the body, but are preferentially accumulated by the Kupffer cells of the liver. Their superparamagnetic properties result in T2 and T2\*

shortening of the tissues that accumulate the particles, which show reduced signal intensity on T2W, T2\*W and, to a lesser extent, T1W images. Most liver tumours do not exhibit uptake, as they are deficient in Kupffer cells. However, as the rest of the liver accumulates SPIO and darkens preferentially, the tumour appears of increased conspicuity. SPIO particles are particularly used, in combination with gadolinium, to improve detection of hepatocellular carcinoma in cirrhotic patients, in whom the parenchymal changes of fibrosis and regenerative nodules make detection with gadolinium alone difficult.

45) A 35-year-old woman on the oral contraceptive pill presents with right upper quadrant pain, shortness of breath and leg oedema. Ultrasound scan of the abdomen demonstrates hepatosplenomegaly and ascites. The hepatic veins are not visualized on Doppler ultrasound scan. What is the most likely diagnosis?

- a. acute Budd–Chiari syndrome
- b. primary biliary cirrhosis
- c. passive hepatic congestion
- d. hepatic veno-occlusive disease
- e. viral hepatitis

45) a. \*\*\*

Budd–Chiari syndrome is caused by obstruction of hepatic venous outflow, which may, in turn, be caused by membranous obstruction of the suprahepatic IVC by a congenital web, or hepatic venous thrombosis due to hypercoagulable state, tumour or trauma. Patients develop hepatosplenomegaly and intractable ascites. Doppler ultrasound scan demonstrates non-visualization of, or thrombus within, one or more hepatic veins. CT findings reflect severely impaired blood flow to the liver, with a 'flip-flop' enhancement pattern after contrast administration. Early images show prominent central liver enhancement with poor peripheral enhancement, whereas delayed images show central washout with peripheral enhancement. The caudate lobe is typically spared because of its separate venous drainage directly into the IVC, and enhances normally. Passive hepatic congestion complicates heart failure, and results in distended hepatic veins and IVC. Hepatic veno-occlusive disease refers to occlusion of small centrilobular hepatic veins following radio- and chemotherapy in bone-marrow transplant recipients, or related to alkaloid consumption. The main hepatic veins and IVC are normal. Hepatic venous involvement is not a feature of viral hepatitis or primary biliary cirrhosis.

46) An 86-year-old, otherwise well woman is admitted with abdominal pain and undergoes plain abdominal radiography. This demonstrates a normal bowel gas pattern, but the liver and spleen are noted to be of increased density with a stippled appearance. What is the most likely cause?

- a. haemochromatosis
- b. thorotrastosis
- c. amiodarone therapy
- d. sickle cell anaemia
- e. glycogen storage disease

46) b. \*\*\*

Thorotrast (thorium dioxide), an alpha-emitting radioactive isotope of atomic number 90 and long half-life, was used as a contrast agent until the mid-1950s, predominantly for cerebral angiography and reticuloendothelial imaging. It is retained indefinitely by the reticuloendothelial system, and results in increased density of the liver, spleen and lymph nodes with a characteristic stippled appearance. It is associated with delayed malignancies, including angiosarcoma, cholangiocarcinoma and hepatocellular carcinoma. Haemochromatosis may result in diffusely increased density of the liver and spleen, but usually presents earlier in life. Amiodarone may result in increased liver attenuation of 95–145 HU (normal 30–70 HU), but splenic involvement is not usually a feature. Sickle cell anaemia can result in a shrunken calcified spleen, but again is unlikely in this age group. Glycogen storage disease can result in a generalized increase or decrease in hepatic density on CT, but increased splenic density is not a feature.

48) A 51-year-old man with alcoholic cirrhosis presents with jaundice. CT of the abdomen reveals an encapsulated, 20 mm focal area of low density in the liver, which demonstrates arterial-phase enhancement and rapid washout on delayed imaging. What is the most likely diagnosis?

- a. regenerative nodule
- b. dysplastic nodule
- c. hepatocellular carcinoma
- d. hepatic haemangioma
- e. focal fatty sparing



48) c. \*\*\*\*

Nodules are a common finding in cirrhosis, and differentiation of benign nodules from hepatocellular carcinoma (occurring in 7–12% of patients) is vital. Most nodules are **regenerative nodules**, representing reparative attempts by hepatocytes in response to liver injury. These are typically under 10mm in size and appear **isodense** to liver parenchyma on CT, unless they contain iron deposits (siderotic nodules), in which case they may be slightly hyperdense. **Dysplastic nodules** are proliferative premalignant lesions found in 15–25% of cirrhotic livers. They resemble regenerative nodules on CT but are usually larger than 10mm. **Hepatocellular carcinomas** usually appear as encapsulated hypodense masses that demonstrate rapid arterial enhancement and early washout of contrast on delayed images. **Hepatic haemangioma** usually appears as a low-density mass, but has different enhancement characteristics, demonstrating peripheral enhancement with complete fill-in on delayed images. **Focal fatty sparing** appears as an area of normal density in a generally hypodense liver and does not demonstrate contrast enhancement.

56) A 27-year-old woman presents with upper abdominal pain and is found to have a palpable right upper quadrant mass on examination. CT demonstrates a low attenuation lesion in the right lobe of the liver. Which imaging feature would favour a diagnosis of fibrolamellar carcinoma of the liver rather than focal nodular hyperplasia?

- a. calcifications within a central scar
- b. lesion size of 3 cm
- c. multiple lesions
- d. increased uptake on sulphur colloid scan
- e. central scar hyperintense on T2W images

56) a. \*\*\*\*

**Fibrolamellar carcinoma** of the liver is an uncommon variant of hepatocellular carcinoma, typically presenting as a large, 5–20 cm liver mass in a young patient with no risk factors. Typical features are of an encapsulated mass with a prominent central fibrous scar. The scar often contains areas of calcification, and appears hypointense on T1- and T2-weighted images. **Focal nodular hyperplasia (FNH)** is a hamartomatous malformation also most commonly seen in young woman. However, lesion size is usually <5 cm and, although a central fibrous scar is also a common feature, this usually appears hyperintense on T2-weighted images due to vascular channels and oedema, and calcifications within it are extremely rare. Both pathologies may result in multiple lesions, with FNH being multiple in 20% and fibrolamellar carcinoma demonstrating satellite lesions in 10–15%. FNH is the only liver lesion with sufficient Kupffer cells to cause normal or increased uptake on sulphur colloid scan.

58) A 45-year-old man undergoes ultrasound scan of the abdomen 2 days following orthotopic liver transplantation, which demonstrates periportal oedema and a small fluid collection at the hilum of the liver. What is the most likely diagnosis?

- a. graft rejection
  - b. hepatic arterial thrombosis
  - c. portal vein stenosis
  - d. bile leak
  - e. normal post-transplantation findings
- Answer: b*



58) e. \*\*\*\*

Orthotopic liver transplantation is the treatment of choice for patients with end-stage liver disease for which no other therapy is available. Surgery involves one arterial anastomosis (hepatic artery), at least two venous anastomoses (portal vein and IVC) and a biliary anastomosis, and complications may occur at any of these sites. Vascular complications are the most frequent cause of graft loss, and most commonly involve the hepatic artery, with portal venous and IVC complications being relatively infrequent. Biliary complications occur in up to 34% of cases, and are the second most common cause of liver dysfunction after graft rejection. They include leak, stricture and obstruction. Other complications include fluid collections, infection and malignancy. Normal findings following liver transplantation include a small amount of free intraperitoneal fluid in the perihepatic region, especially at the hilum, or in the fissure for the ligamentum teres, which usually resolves within a few weeks. Other normal findings are a right fluid pleural effusion, and periportal oedema, attributed to lymphatic channel dilatation due to lack of normal lymphatic drainage.

- 66) A 40-year-old man with hyperpigmentation, arthralgia and diabetes mellitus is clinically suspected to have primary haemochromatosis. What are the most likely findings on liver MRI in this condition?
- a. normal appearances of the liver
  - b. decreased signal intensity on T1W and T2W images
  - c. decreased signal intensity on T1W and increased signal intensity on T2W images
  - d. increased signal intensity on T1W and decreased signal intensity on T2W images
  - e. increased signal intensity on T1W and T2W images

66) b. \*\*\*

In primary haemochromatosis, there is increased duodenal absorption and parenchymal retention of dietary iron, which is accumulated within the liver, pancreas, heart and pituitary gland. Intracellular iron deposits within hepatocytes result in a paramagnetic susceptibility effect, leading to marked shortening of T1 and T2 relaxation times of adjacent protons.

This manifests as a marked reduction in liver signal intensity on T2W and T2\*W images, and a moderate loss of signal intensity on T1W images.

69) A 54-year-old woman undergoes CT of the abdomen and pelvis for weight loss and is found to have multiple, irregular, calcified, low-attenuation lesions in the liver, suggestive of metastases. What is the most likely primary lesion?

- a. invasive ductal carcinoma of the breast
- b. mucinous adenocarcinoma of the gastrointestinal tract
- c. osteosarcoma
- d. non-small-cell lung carcinoma
- e. carcinoid

69) b. \*\*\*

Calcified liver metastases represent up to 3% of liver metastases, and are most commonly seen with mucinous carcinomas of the gastrointestinal tract. They are also seen in osteosarcoma, breast cancer, lung cancer and carcinoid, but these are less common.



- 72) A 45-year-old woman undergoes abdominal ultrasound scan. The portal vein measures 16 mm in diameter and demonstrates continuous monophasic flow without respiratory variation. Portal vein flow velocity is hepatopetal and is measured to be 7 cm/s. What is the most likely diagnosis?
- a. normal findings
  - b. Budd–Chiari syndrome
  - c. portal hypertension
  - d. cavernous transformation of the portal vein
  - e. portal vein thrombosis

72) c. \*\*\*\*

The normal portal vein measures up to 13 mm in diameter when measured in the AP direction where the portal vein crosses the inferior vena cava during quiet respiration in a supine patient. Portal venous flow is normally 12–30 cm/s and demonstrates respiratory variation but little or no pulsatility, though this may be seen in thin patients. Normal flow is hepatopetal (anterograde flow into the liver). Portal hypertension is defined as an increase in portal venous pressure above 10 mmHg, and is most commonly caused by cirrhosis in the western world. As portal pressure increases, portal vein diameter increases, and portal flow loses its respiratory fluctuation and becomes slow and turbulent. Reversed (hepatofugal) flow may occur in 8% of patients and is generally associated with a reduced portal vein diameter. Other findings include portosystemic collaterals, splenomegaly and ascites. In portal vein thrombosis, portal vein diameter increases, but no flow is seen on

Doppler ultrasound scan. Echogenic thrombus may be seen within the lumen. Cavernous transformation of the portal vein may occur with chronic portal vein thrombosis, representing a conglomerate of collateral veins. Budd–Chiari syndrome affects the hepatic veins.

- 86) A 26-year-old man with AIDS presents with weight loss. He is noted to have multiple raised purple skin lesions on examination. Contrast-enhanced CT of the abdomen and pelvis demonstrates multiple, subcentimetre, low-attenuation nodules within the liver, as well as high-attenuation lymphadenopathy at the porta hepatis, retrocaval and aortocaval regions. What is the most likely diagnosis?
- a. fungal infection
  - b. multiple haemangiomas
  - c. lymphoma
  - d. Kaposi's sarcoma
  - e. mycobacterial disease

86) d. \*\*

Kaposi's sarcoma is a low-grade tumour of the blood and lymphatic vessels that primarily affects the skin but may cause disseminated disease in other organs. It is an AIDS-defining illness and is the most common AIDS-related neoplasm. The commonest manifestation is of multiple raised purplish skin lesions, but lymphadenopathy is the second commonest feature in AIDS-related Kaposi's sarcoma. Typical appearances are of abdominopelvic lymph nodes that enhance after intravenous contrast due to high vascularity, appearing to be of higher attenuation than skeletal muscle. Liver involvement occurs in 34% of cases at autopsy, and typically causes multiple 5–12mm nodules that are hyperechoic on ultrasound scan and of low attenuation on CT. Skin lesions are present in most cases, and help to distinguish Kaposi's sarcoma from other conditions such as fungal microabscesses and multiple haemangiomas, which may have similar appearances on CT. Mycobacterial disease is characteristically associated with low-attenuation lymphadenopathy. Non-Hodgkin's lymphoma is the second commonest AIDS-related neoplasm, and may cause multiple

low-attenuation liver lesions, but it is not associated with skin lesions or high-attenuation lymphadenopathy.



- 91) A 45-year-old woman undergoes a follow-up staging CT of the chest, abdomen and pelvis after treatment for metastatic breast cancer. Compared with her initial staging scan, there is a generalized decrease in the attenuation value of the liver. No focal liver lesion or other new feature is seen. What is the most likely cause?
- a. diffuse metastatic disease
  - ☒ b. fatty liver related to chemotherapy
  - c. hepatic venous congestion
  - d. amyloidosis
  - e. Budd–Chiari syndrome

91) b. \*\*\*

Chemotherapeutic agents are commonly associated with fatty liver. Diffuse fat deposition (the commonest pattern) causes a generalized decrease in the attenuation value of the liver on CT, and may be diagnosed with an absolute liver attenuation value of less than 40 HU on contrast-enhanced CT. It may also be diagnosed at unenhanced CT if the liver attenuation value is at least 10 HU less than that of the spleen. Liver metastases usually present as focal, low-attenuation lesions on portal phase imaging. Hepatic venous congestion causes a diffuse decrease in attenuation but is associated with enlargement of the inferior vena cava and hepatic veins due to elevated central venous pressure. Amyloidosis can cause a generalized decrease in liver attenuation, but more commonly appears as discrete areas of low attenuation with reduced contrast enhancement. Budd–Chiari syndrome may also result in a diffuse decrease in liver attenuation, but there is usually patchy liver enhancement and poor visualization of the hepatic veins.



9. An 83 year old woman is investigated for weight loss, and undergoes contrast-enhanced CT scan of the chest, abdomen and pelvis. Multiple hypervascular metastases are found in the liver. Which one of the following is most likely to be the primary tumour?
- a. Adenocarcinoma of the stomach
  - b. Invasive ductal carcinoma of the breast
  - c. Carcinoid tumour
  - d. Adenocarcinoma of the sigmoid
  - e. Pancreatic ductal adenocarcinoma

9. c. Carcinoid tumour

Of the options listed, carcinoid tumour is the only primary tumour that typically causes hypervascular liver metastases. Other causes of hypervascular liver metastases are pancreatic islet cell tumours, phaeochromocytoma and renal cell carcinoma. Stomach, breast, lung and colon cancers are associated with hypovascular liver metastases. Liver metastases from carcinoid tumours are more common with increasing size of the primary tumour. The incidence of metastases depends on the location of the primary tumour, where approximately 30% of carcinoids of the ileum metastasise compared to less than 5% of carcinoids of the appendix.

### Hypervascular Liver metastasis

#### **CHIMP**

**C**arcinoid

**H**ypernephroma

**I**slet cell tumor

**M**elanoma

**P**heochromocytoma

## **Echogenic liver metastasis**

- Colonic carcinoma (mucinous adenocarcinoma)
- Hepatoma
- Treated breast carcinoma

16. An asymptomatic 46 year old woman has an MR liver following an incidental finding of a focal mass in the right lobe of the liver on ultrasound. The MR shows an 8 cm isolated lesion. It is high signal on T1-weighted sequences and isointense on T2-weighted sequences relative to the normal liver parenchyma. The lesion is most likely to be which one of the following?
- a. Hepatocellular carcinoma
  - b. Liver metastasis
  - c. Haemangioma
  - d. Fibronodular hyperplasia
  - e. Adenoma

### **16. e. Adenoma**

The lesion is most likely to be a hepatic adenoma. None of the other diagnoses typically share these imaging characteristics. Adenomas are benign growths of hepatocytes and are most commonly seen in young women, particularly associated with oral contraceptive use. Eighty per cent are solitary and found in the right lobe of the liver. The high signal on T1-weighted sequences is due to the presence of fat and/or haemorrhage and can distinguish between this and many other lesions in the liver which tend to be of low T1 signal on MR (e.g. metastases, HCC, haemangiomas and FNH). Occasionally, imaging features can overlap with FNH and the two lesions can be difficult to distinguish. However, the majority of FNH lesions are less than 5 cm in size, whereas adenomas tend to be larger.

17. A 26 year old female has an ultrasound scan for right upper quadrant pain and a heterogenous 5 cm solitary liver lesion with central calcifications, and a hyperechoic scar is seen. Blood tests reveal a negative alpha-fetoprotein. MR shows the lesion is hypointense on T1 and hyperintense on T2-weighted imaging. The central scar is hypointense on both sequences. Which of the following diagnoses is most likely?
- a. Hepatic lymphoma
  - b. Hepatocellular carcinoma
  - c. Fibrolamellar carcinoma
  - d. Hepatoblastoma
  - e. Hepatic angiosarcoma

17. c. **Fibrolamellar carcinoma**

Fibrolamellar carcinoma occurs in young adults in the absence of normal risk factors for hepatocellular carcinoma. On ultrasound, fibrolamellar carcinoma is of mixed or increased echogenicity, and the hyperechoic central scar is often evident. On unenhanced CT the lesion is of low attenuation, displaying heterogenous enhancement with intravenous contrast administration. The central scar is typically of low signal on both T1- and T2-weighted imaging, which can help differentiate it from FNH (whose scar typically is of low signal on T1 but high signal on T2-weighted imaging). The central scar is present in up to 60% of patients. Calcifications are present in up to 55% and are more common than in hepatocellular carcinoma.

28. A 53 year old male is investigated for recurrent episodes of biliary colic. Blood tests reveal eosinophilia and normal liver function tests. Abdominal ultrasound demonstrates a 7 cm cystic structure with a thin hyperechoic wall and several smaller satellite cysts up to 2 cm adjacent to the lesion. Which one of the following diagnoses is most likely?
- a. Hydatid cyst
  - b. Pyogenic abscess
  - c. Amoebic abscess
  - d. Schistosomiasis
  - e. Hepatocellular carcinoma

**28. a. Hydatid cyst**

The most likely diagnosis is hydatid cyst disease. This condition is caused by infection of the liver with the parasite *Echinococcus granulosus*. Blood eosinophilia is present in up to 50% of patients. It is more common in the right lobe of the liver and is multiple in 20% of cases. Daughter cysts are typical. Percutaneous aspiration of the cyst is positive for hydatid disease in 70%.

**37. A 52 year old male has an unenhanced CT KUB for left renal colic. No cause for the pain is discovered on the CT, however the liver is found to be of increased density relative to the spleen. Which one of the following would be most likely to explain this incidental finding?**

- a. Excess alcohol intake
- b. Amiodarone use
- c. Diabetes
- d. Steroids
- e. Past history of chemotherapy

**37. b. Amiodarone use**

The normal liver is between 30 and 70 HU on unenhanced CT, and should be 10–15 HU lower than spleen density. On portal venous phase the liver will be approximately 25 HU less than the spleen. Amiodarone contains iodine and can cause the liver to appear of increased density on CT. Other causes include cisplatin use, haemochromatosis, Wilson disease and glycogen storage diseases. The more common finding on CT is a liver of decreased density due to a fatty liver. This has many causes including alcohol use, steroids, chemotherapy, diabetes and nutritional causes.

43. A 42 year old woman undergoes a CT abdomen and pelvis for the investigation of right upper quadrant pain and deranged liver function tests. On early post-intravenous contrast images there is prominent enhancement of the central liver and weak enhancement of the peripheral liver. This pattern is reversed on delayed images. In addition there is hypertrophy of the caudate lobe. Which one of the following would most likely explain these findings?
- a. Acute hepatitis
  - b. Cirrhosis
  - c. Budd-Chiari syndrome
  - d. Portal hypertension
  - e. Fatty liver

43. c. Budd-Chiari syndrome

Budd-Chiari syndrome is outflow obstruction of the hepatic veins due to a wide variety of causes, but two-thirds are idiopathic. CT features include 'flip-flop' enhancement pattern as described in the question, ascites, hepatosplenomegaly, gallbladder wall thickening and increased portal vein diameter. An enlarged caudate lobe is seen in up to 88%, which enhances normally due its venous drainage passing directly into the IVC.

44. A 61 year old man undergoes CT abdomen and pelvis for characterisation of a well-defined hyperechoic area seen on ultrasound in the perihilar region of the liver. On CT the area is of decreased attenuation but has no obvious mass effect. There is no abnormal enhancement with intravenous contrast administration. Which one of the following diagnoses is most likely?
- a. Focal nodular hyperplasia
  - b. Focal fatty infiltration
  - c. Hepatic cyst
  - d. Liver haemangioma
  - e. Fibrolamellar carcinoma



**44. b. Focal fatty infiltration**

Focal fatty infiltration occurs typically in the periportal and centrilobar regions of the liver and is commonest adjacent to the falciform ligament. Ultrasound features include a hyperechoic area with geographic margins. CT shows an area of decreased attenuation which does not alter the course of blood vessels or liver contour. The lesions are of high signal on T1-weighted MR imaging, and isointense or low signal on T2-weighted imaging. Haemangiomas would also typically be of increased echogenicity on ultrasound, but would be expected to show increased peripheral enhancement with intravenous contrast on CT.

48. A 41 year old female has an MRI liver following a solitary 3 cm lesion in the right lobe of the liver. The lesion is isointense on T1-weighted and slightly hyperintense to liver parenchyma on T2-weighted imaging. There is immediate intense homogenous enhancement with gadolinium in the arterial phase, which becomes isointense on the venous phase. A central scar is hypointense on T1 and hyperintense on T2-weighted sequences. Which one of the following is the most likely diagnosis?

- a. Adenoma
- b. Cavernous haemangioma
- c. Fibrolamellar carcinoma
- d. Regenerative nodules
- e. Focal nodular hyperplasia

**48. e. Focal nodular hyperplasia**

These imaging features are typical of focal nodular hyperplasia. This is the second most common benign liver tumour and typically occurs in women more often than in men. Adenomas are usually larger, enhance less brightly and do not typically have a central fibrous scar. Cavernous haemangiomas are usually high signal on T2-weighted images, and of blood pool intensity on contrast-enhanced T1-weighted images. Fibrolamellar carcinoma also has a central scar, but this is typically of low signal intensity on T2-weighted imaging. Regenerative nodules show high signal intensity on unenhanced T1-weighted imaging and do not have a scar.

49. A 71 year old woman with no significant past medical history has an abdominal ultrasound as part of an investigation for right upper quadrant pain, anaemia and weight loss. Multiple, poorly defined, markedly echogenic lesions are seen throughout the liver. Biopsy reveals these to be metastases. Which one of the following is most likely to be the primary tumour?
- a. Adenocarcinoma of the colon
  - b. Melanoma
  - c. Invasive ductal carcinoma of the breast
  - d. Gastric cancer
  - e. Pancreatic ductal adenocarcinoma

49. a. Adenocarcinoma of the colon

The most common primary tumours that cause brightly echogenic liver metastases are colonic adenocarcinoma, treated breast cancer and hepatoma. The differential here therefore lies between breast cancer and colon cancer. Colon cancer makes up at least 50% of highly echogenic metastases. In addition the question states that the patient has no significant past medical history, and therefore treated breast cancer is unlikely.

51. A 25 year old female becomes unwell six hours after induced delivery for pre-eclampsia with severe right upper quadrant pain, oedema and nausea. CT of the abdomen and pelvis reveals copious ascites and multiple wedge-shaped areas of liver non-enhancement consistent with hepatic infarction. Which of the following is the most likely underlying cause?
- a. Hepatic artery embolus
  - b. Portal vein thrombosis
  - c. SVC occlusion
  - d. HELLP syndrome *⇒ Haemolysis, elevated liver enzymes & low platelets*
  - e. Splenic vein thrombosis

51. d. HELLP syndrome

Hepatic infarction is rare because of the dual blood supply to the liver via the hepatic arterial system and the portal venous system. Isolated pathology in either of these vascular supplies is unlikely to cause hepatic necrosis as the other supply will usually compensate. HELLP is characterised by haemolysis, elevated liver enzymes and low platelets and is one of the causes of liver infarction.

52. A 47 year old female with a history of surgery for breast carcinoma is referred for ultrasound after liver function tests show a mildly elevated alkaline phosphatase. The bile ducts are normal but a 3 cm hyperechoic liver lesion is seen in the right lobe. CT is recommended, which shows a focal mass with nodular hyperenhancement of the periphery on arterial phase imaging becoming isointense to the background liver on delayed phase scanning at five minutes. Which one of the following is the most likely diagnosis?

- a. Fibrolamellar carcinoma
- b. Adenoma
- c. Cavernous haemangioma
- d. Adenocarcinoma metastases
- e. Focal nodular hyperplasia

**52. c. Cavernous haemangioma**

Metastases may show peripheral enhancement with complete fill-in on delayed images, but they typically show complete rather than nodular peripheral enhancement and washout on delayed phase imaging. Only haemangiomas typically show peripheral nodular enhancement. Cavernous haemangiomas are the most common benign liver tumours and are usually less than 4 cm in size. Seventy per cent are hyperechoic on ultrasound and they may show acoustic enhancement.

53. A 33 year old female presents to A&E with right upper quadrant pain, hypotensive and tachycardic. CT abdomen and pelvis reveals an 11 cm diameter well-defined heterogeneous mass within the right lobe of the liver, predominantly of low density but with three focal areas of higher attenuation ( $>90$  HU) within it. There is layered high-attenuation fluid within the subhepatic and right subdiaphragmatic space tracking down to the pelvis. Which one of the following is the correct combination of recommendations?

- a. Adenoma – recommend surgical referral
- b. Adenoma – recommend correct coagulopathy and rescan if it deteriorates
- c. Adenoma – recommend endovascular embolisation
- d. Metastatic hepatocellular carcinoma – recommend gastroenterology referral
- e. Trauma – needs CT thorax to clear other injuries

**53. c. Adenoma – recommend endovascular embolisation**

Adenomas are vascular lesions comprising hepatocytes. They may occasionally present with massive haemorrhage, and are the most common liver lesion to do so in young people. In this scenario there is active extravasation of contrast implying active bleeding and haemoperitoneum. Urgent embolisation is the most appropriate treatment to halt bleeding. Conservative or surgical management is unlikely to provide rapid haemostasis. As a proportion of adenomas become malignant, they are usually removed surgically.

54. A 54 year old male has a liver MR for characterisation of a 3 cm low-attenuation lesion found on staging CT for rectal carcinoma. Which one of the following characteristics would be most worrying for a metastasis rather than a benign lesion?

- a. Peripheral washout on delayed imaging
- b. Intense arterial enhancement
- c. Peripheral nodular enhancement
- d. Presence of a pseudocapsule
- e. Low signal intensity on T1-weighted imaging

**54. a. Peripheral washout on delayed imaging**

Peripheral washout of contrast on delayed imaging is virtually diagnostic of malignancy. On post-gadolinium-enhanced T1-weighted images most metastases are hypovascular compared with the surrounding liver and are most conspicuous at the portal phase of enhancement. However, virtually all metastases exhibit a complete ring of peripheral enhancement, which is best seen in the early arterial phase.



55. A 63 year old male has a CT abdomen and pelvis for the investigation of change in bowel habit and weight loss. A sigmoid tumour is demonstrated and there is a solitary liver metastasis. Which one of the following observations on CT would render the patient ineligible for curative resection of the liver metastasis?
- a. Presence of a single peripheral left lower lobe pulmonary metastasis
  - b. Presence of splenic metastasis
  - c. Direct extension of the liver metastasis into the right adrenal gland
  - d. Involvement of the caudate lobe
  - e. Peritoneal metastases

**55. e. Peritoneal metastases**

Generally accepted contraindications to liver resection would include uncontrollable extrahepatic disease such as: non-treatable primary tumour; widespread pulmonary disease; locoregional recurrence; peritoneal disease; extensive nodal disease, such as retroperitoneal, mediastinal or portal nodes; and bone or CNS metastases. Patients with extrahepatic disease that should be considered for liver resection include: resectable/ablatable pulmonary metastases; resectable/ablatable isolated extrahepatic sites – for example, spleen, adrenal or resectable local recurrence; and local direct extension of liver metastases to, for example, the diaphragm or adrenal glands, which can be resected.

- 37 A diabetic 50-year-old man was investigated for hepatic disease. His liver was enlarged and he had hyperpigmentation of his skin. His serum iron was >300 mg/dL and serum transferrin saturation was >50%. What imaging feature is most characteristic of the underlying diagnosis?
- a Increase in hepatic echogenicity on US
  - b Patchy echogenicity demonstrated on US
  - c Decrease in hepatic T1 signal on MR
  - d Decrease in hepatic attenuation on CT
  - e Decrease in hepatic T2 signal on MR

37 Answer E: Decrease in hepatic T2 signal on MR

Haemochromatosis can be primary or secondary. The primary form shows autosomal recessive inheritance and usually presents after middle age, particularly in women where menstruation is protective. Hepatomegaly and hyperpigmentation are seen in 90%. Diabetes can occur in up to 30% secondary to pancreatic beta cell damage. Significant signal loss on T2WI is very characteristic.

- 39 Following a holiday in South-East Asia, a 33-year-old man presented with abdominal pain. Ultrasound demonstrated an echo-poor lesion within the right lobe of the liver which contained several smaller internal cysts. What is the most likely diagnosis?
- a Amoebic abscess
  - b *Echinococcus*
  - c Pyogenic abscess
  - d Polycystic liver disease
  - e Haemangioma

39 Answer C: *Echinococcus*

- 40 A 67-year-old woman noticed an abdominal mass and was referred for an ultrasound scan. This showed a large, uniformly hyperechoic mass in the left lobe of the liver. A subsequent multi-phase contrast-enhanced CT confirmed this mass which enhances peripherally until it becomes isoattenuating with the adjacent liver parenchyma after five minutes. What is the most likely diagnosis?
- a Adenoma
  - b Haemangioma
  - c Hepatocellular carcinoma
  - d Focal nodular hyperplasia
  - e Solitary metastasis

**40 Answer B: Haemangioma**

Hepatic haemangioma are the commonest benign liver tumours. They are typically hyperechoic on ultrasound and demonstrate centripetal enhancement with delayed 'fill-in' on contrast-enhanced CT. Enhancing focal liver lesions can be usefully characterised according to the phase of their enhancement. Other lesions that show delayed (equilibrium phase) enhancement include: cholangiocarcinoma, solitary fibrous tumour and treated metastases.

**41** A 38-year-old woman presented with upper abdominal discomfort. She was otherwise well and was taking the combined oral contraceptive pill. Physical examination was normal. An ultrasound showed a well-circumscribed, homogeneous 4-cm mass in the liver and she was subsequently referred for a liver MRI. What feature would be most useful in distinguishing focal nodular hyperplasia from adenoma?

- a Calcification
- b Internal haemorrhage
- c Multiple lesions
- d Uptake of reticuloendothelial contrast
- e Uptake of hepatobiliary contrast

**41 Answer E: Uptake of hepatobiliary contrast**

Reticuloendothelial contrast agents, such as Ferrioxan, carboxydextran-coated iron oxide nanoparticles (Resovist®) are taken up by both focal nodular hyperplasia (FNH) and adenoma. Hepatobiliary contrast agents, such as Gadolinium-Benzylxypropionic tetra-acetate (Gd-BOPTA or MultiHance®) are not taken up by adenoma.

- 42 A middle-aged man with symptoms of lethargy and painful hands presented to his doctor. Routine blood tests showed deranged liver function and plain radiographs of his hands showed an arthropathy primarily affecting the first and second metacarpophalangeal (MCP) joints. He was referred to a hepatologist and an abdominal CT was arranged. The liver was of diffusely increased density prior to contrast administration. What is the most likely underlying diagnosis?
- a Amiodarone treatment
  - b Glycogen storage disorder
  - c Haemochromatosis
  - d Primary biliary cirrhosis
  - e Rheumatoid arthritis

42 Answer C: Haemochromatosis

Causes of increased liver attenuation pre-intravenous contrast include: haemochromatosis, haemosiderosis, iron overload, glycogen storage disease and amiodarone treatment.

- 43 A 58-year-old African woman was visiting her grandchildren in London when she developed right upper quadrant pain. The local doctor, suspecting gallstones, arranged an ultrasound which showed a grossly cirrhotic liver with markedly hyperechoic septa separating areas of relatively normal liver. The scanning radiologist recognised this as a 'turtle back' appearance. What is the most likely underlying diagnosis?
- a Amoebiasis
  - b Hydatid
  - c Lymphoma
  - d Schistosomiasis
  - e Tuberculosis

43 Answer D: Schistosomiasis

The described ultrasound appearances are typical of schistosomiasis. Radiological features rarely develop until the late stages and are signs of cirrhosis and fibrosis. Patients are at a significantly increased risk of hepatocellular carcinoma (HCC).



- 44 A 17-year-old male developed upper abdominal pain and abdominal distension two days after an appendectomy. He had been dehydrated on presentation but the operation was uncomplicated. Transabdominal ultrasound showed a large volume of ascites and a diagnosis of portal vein thrombosis was considered. What sonographic finding is most commonly seen that would support this diagnosis?
- a Portosystemic collateral circulation
  - b Increase in portal vein diameter
  - c Echogenic material in the portal vein lumen
  - d Enlargement of a thrombosed portal vein above 15 mm
  - e Enlargement of the lesser omentum

44 Answer C: Echogenic material in the portal vein lumen

Echogenic material in the portal vein lumen (67%), increased in portal vein diameter (57%), portosystemic collateral circulation (48%), enlargement of a thrombosed portal vein above 15 mm (38%).

- 37 A 37-year-old male with known alcoholic liver disease causing severe cirrhosis and multiple previous admissions for gastrointestinal haemorrhage was recently treated with a transjugular intrahepatic porto-systemic shunt (TIPS). Unfortunately, he has developed encephalopathy as a result of decompensated liver disease and the gastroenterologist would like to know if the TIPS is patent. What is the most appropriate first-line investigation to determine this?
- a Ultrasound of the liver with Doppler
  - b Triple-phase intravenous contrast-enhanced CT
  - c Time of flight gadolinium-enhanced MR
  - d Fluoroscopy with venous catheter-based contrast injections
  - e Double-phase intravenous contrast-enhanced CT

37 Answer A: Ultrasound of the liver with Doppler

Doppler ultrasound is a reliable, non-invasive method in assessing shunt patency.

- 38 A 35-year-old male with protein C deficiency presented with a history of a few weeks of abdominal pain, increasing abdominal distension and jaundice. Biochemistry revealed grossly abnormal liver function tests and his coagulation was also markedly abnormal. An ultrasound demonstrated widespread ascites with hypertrophy of the caudate lobe and bicoloured flow in the hepatic veins on Doppler. What is the most likely diagnosis?
- a Acute Budd-Chiari syndrome
  - b Alcoholic liver disease
  - c Chronic Budd-Chiari syndrome
  - d Portal vein thrombosis
  - e Right heart failure

38 Answer C: Chronic Budd-Chiari syndrome

In acute Budd-Chiari syndrome the caudate lobe does not hypertrophy as it does in the chronic form (as it has separate drainage directly into the IVC). There are various causes of Budd-Chiari syndrome; 66% are idiopathic.

- 39 A young woman developed haematuria and was referred for a renal tract ultrasound. She was not on any medication other than the combined oral contraceptive pill. There were no positive renal tract findings, but while scanning the right kidney the ultrasonographer noticed a solitary isoechoic lesion in the right lobe of the liver. Following further assessment, the patient was referred for a contrast-enhanced MRI, primarily to discriminate between focal nodular hyperplasia (FNH) and adenoma. What radiological finding would support a diagnosis of FNH?
- a Internal haemorrhage
  - b Calcification
  - c Central scar
  - d Poor uptake of hepatobiliary liver contrast (Gd-BOPTA)
  - e Uptake of reticuloendothelial liver contrast

39 Answer C: Central scar

- 40 A 42-year-old man with known alcohol-related cirrhosis was assessed in the Hepatology outpatient clinic. Blood samples were taken for serum bilirubin, albumin and prothrombin time and evidence of hepatic encephalopathy was sought clinically. An abdominal ultrasound was requested to complete Child-Pugh cirrhosis scoring. What feature of ultrasound is used to complete the Child-Pugh score?
- a Ascitic fluid
  - b Collateral vessel formation
  - c Portal venous flow
  - d Splenomegaly
  - e Varices

40 Answer A: Ascitic fluid

The Child-Pugh score is derived from bilirubin and albumin levels, prothrombin time, hepatic encephalopathy and presence ascites.

- 41 An adult patient presented with non-specific symptoms suggestive of malignancy and an abdominal ultrasound showed multiple 'target-lesions' throughout the liver consistent with hepatic metastatic deposits. Without knowing the patient's age or gender, what is the most likely site of the primary tumour?
- a Breast
  - b Colorectal
  - c Bronchogenic
  - d Pancreatic
  - e Gastric

41 Answer B: Colorectal

Colorectal > Gastric > Pancreatic > Breast > Lung

- 42 A gap-year student returned from a long trip to Africa having experienced a few episodes of bloody diarrhoea. She then developed increasingly severe right upper quadrant pain and was referred for an abdominal ultrasound. This showed a solitary 8-cm, hypoechoic thin-walled lesion in the right lobe of the liver. Subsequent percutaneous drainage yielded reddish brown thick fluid. What is the most likely causative organism?
- a *Echinococcus* sp.
  - b *Entamoeba histolytica*
  - c *Escherichia coli*
  - d *Schistosoma* sp.
  - e *Staphylococcus aureus*

42 Answer B: *Entamoeba histolytica*

Amoebic abscesses typically present as a large solitary lesion in the right lobe of the liver. The contents have been described as 'anchovy paste' or 'chocolate sauce'.

- 44 A 17-year-old Greek boy presented with abdominal pain. He was of short stature but otherwise of normal physical appearance. Blood tests showed a microcytic anaemia and abnormal liver function tests. On ultrasound his liver measured 18 cm in cranio-caudal length; in the right mid-clavicular line his spleen measured 15 cm in longest axis. Gallstones were also noted in an otherwise normal gallbladder. What is the most likely diagnosis?
- a Sarcoidosis
  - b Glycogen storage disease
  - c Beta-thalassaemia
  - d Recent viral infection
  - e Leukaemia

44 Answer C: Beta-thalassaemia

All the options are causes of hepatosplenomegaly. Beta-thalassaemia is more common in the Mediterranean population and can cause microcytic anaemia and abnormal liver function. Affected patients are at increased risk of developing gallstones.



- 37 A middle-aged female underwent an abdominal ultrasound which demonstrated an area of increased reflectivity within the right lobe of her liver. She has no significant past medical history and a benign haemangioma is suspected. Were she to have an MRI what would the most likely signal characteristics of this lesion be?
- a Hypointense T1 and hyperintense T2
  - b Hypointense T1 and hypointense T2
  - c Hyperintense T1 and hyperintense T2
  - d Hyperintense T1 and hypointense T2
  - e Hyperintense T1 and isointense T2

37 Answer A: Hypointense T1 and hyperintense T2

- 39 Which of the following is an expected normal finding following liver transplant?
- a Hepatic arterial resistive index  $<0.5$
  - b Hepatic infarction
  - c Increased periportal attenuation
  - d Periportal lymphadenopathy
  - e Portal vein thrombosis

39 Answer C: Increased periportal attenuation

- 40 A focal liver abnormality was detected in a middle-aged man and he subsequently underwent a liver MRI to further delineate the lesion. The MRI showed the lesion to be hyperintense on T1-weighted sequences and hypointense on T2-weighted sequences. What lesion is most likely to exhibit this pattern of signal return?
- a Adenoma
  - b Regenerative nodule
  - c Focal nodular hyperplasia
  - d Haemangioma
  - e Metastases

40 Answer A: Adenoma

Most focal liver lesions are hypointense on T1WI. Exceptions to this rule include: adenoma, fatty lesions, blood, proteinaceous material, melanoma metastases and contrast agents.

41 A patient with a known colorectal carcinoma was being investigated for possible liver metastases. What modality is most sensitive in detecting liver metastases?

- a Contrast-enhanced CT
- b ERCP
- c MRI
- d FDG PET-CT
- e Ultrasound

41 Answer C: MRI

Sensitivity for detection of liver metastases: MR > CECT > FDG PET-CT.

42 A middle-aged man, known to have acute leukaemia, was referred for an abdominal ultrasound. Several small, uniformly hypoechoic nodules were visible within the liver, which were thought to represent foci of hepatic candidiasis and resolved following empirical treatment with antifungal drugs. Via what route is it most likely that the fungal infection spread to the liver?

- a Biliary ducts
- b Hepatic artery
- c Percutaneous
- d Portal vein
- e Transcoelomic

42 Answer B: Hepatic artery

Unlike pyogenic and amoebic infections, which usually enter the liver via the biliary ducts or portal vein, fungal infections typically enter via the hepatic artery.

- 43 A 30-year-old man with known polycythaemia rubra vera was referred for contrast-enhanced CT for investigation of progressive abdominal distension and jaundice. This showed ascites, caudate and right hepatic lobar hypertrophy with mosaic enhancement of the liver. There was also a low attenuation 2-cm lesion in segment 2 which showed peripheral nodular enhancement. A delayed phase scan showed filling in of the segment 2 lesion, but the remaining liver enhancement was markedly delayed. What is the most likely diagnosis?
- a Hepatocellular carcinoma
  - b Liver metastases
  - c Cirrhotic liver disease
  - d Budd-Chiari syndrome
  - e Alcoholic hepatitis

43 Answer D: Budd-Chiari syndrome

- 45 In a normal unenhanced CT scan of the upper abdomen, the liver parenchyma measures 65 HU. What would be the expected density of the spleen?
- a 20–30 HU
  - b 40–60 HU
  - c 65 HU
  - d 70–80 HU
  - e 100–120 HU

45 Answer B: 40–60 HU

Unenhanced CT spleen approximately 40–60 HU, and 5–10 HU less than liver.

- 70 A four-month-old child presented with hyperpigmented wheal and flare skin lesions. An abdominal ultrasound showed hepatosplenomegaly and some enlarged retroperitoneal lymph nodes. Examination of the bowel showed ileal wall thickening and further investigations showed distorted thickened nodular folds in the ileum. What is the most likely diagnosis?
- a Carcinoid
  - b Down syndrome
  - c Mastocytosis
  - d Pheochromocytoma
  - e Trisomy 18

70 Answer C: Mastocytosis

Mastocytosis is a systemic disease where there is mast cell proliferation. Over 50% present before six months old. Urticaria pigmentosa is seen in up to 90% and disease is seen in the skeletal, reticuloendothelial and abdominal systems.

11. A lesion is noted in the liver on CT and ultrasound. It is inferior, anterior, and to the left of the right hepatic vein, but to the right of the middle hepatic vein. It is inferior of the confluence of the right and left portal veins. According to the Couinaud system, what segment of the liver is the lesion in?
- A. Segment 4b.
  - B. Segment 5.
  - C. Segment 6.
  - D. Segment 7.
  - E. Segment 8.

11. B. Segment 5.

For a review of the segmental anatomy of the liver, please see the reference below.

Dahnert W. *Radiology Review Manual*, 6th edn, Lippincott Williams & Wilkins, 2007. p. 684.

**12. A 56-year-old male patient is referred for an ultrasound of abdomen prior to undergoing an anterior resection for a proximal rectal carcinoma. The ultrasound reveals a 2cm lesion in the right lobe of the liver, which is hyperechoic centrally with a hypoechoic rim. Which one of the following cannot be considered in the differential for this lesion?**

- A. Metastases.
- B. Haemangioma.
- C. Sarcoid.
- D. Candidiasis.
- E. Lymphoma.

**12. B. Haemangioma.**

The ultrasound findings describe a target lesion or bull's eye lesion. Cavernous haemangiomas can have unusual appearances, but a small lesion such as described will normally have a uniform hyperechoic appearance. Of all the other lesions described, metastasis would be top of the differential, although this appearance is not the most classical for a colonic metastasis.

**23. A 40-year-old female undergoes MRI of the liver, which demonstrates a 5-cm lesion that is isointense to liver on T1WI and slightly hyperintense on T2WI. It has a central scar that is hypointense on T1WI and hyperintense on T2WI. On contrast-enhanced dynamic MRI, the lesion is hyperintense in the arterial phase, and isointense to liver in the portal venous phase with delayed filling in of the central scar. What is the diagnosis?**

- A. Hepatic adenoma.
- B. Fibrolamellar hepatoma.
- C. Hypervascular metastasis.
- D. Focal nodular hyperplasia (FNH).
- E. Giant haemangioma.



**23. D. Focal nodular hyperplasia (FNH).**

This is the second most common benign liver tumour. It is thought to represent a hyperplastic response of hepatocytes to an underlying vascular malformation. It is most common in young adult females and is usually an asymptomatic solitary lesion. On histology, FNH consists of hyperplastic hepatocytes and small bile ductules around a central scar. The bile ductules of FNH do not communicate with the adjacent biliary tree. At ultrasound, FNH is isoechoic or hypoechoic. Colour Doppler may show prominent central vascularity. At CT, FNH is typically slightly hyperattenuating or isoattenuating to surrounding liver on precontrast images. On post contrast images, FNH is hyperattenuating in the arterial phase and isoattenuating in the portal venous phase with hypoattenuating central scar. The scar shows delayed enhancement. At MRI, FNH is iso- to hypointense on T1WI and slightly hyper- to isointense on T2WI. The central scar is hypointense on T1WI and hyperintense on T2WI. The enhancement pattern is similar to that on CT. If the appearances are atypical, MRI with hepatocyte-specific contrast agent (gadobenate dimeglumine) may be useful in confirming the hepatocellular origin of the mass. With gadobenate dimeglumine, FNH is iso- to hyperintense on the 1–3 hour delayed images in over 96% of cases.

**25. A 45-year-old female is suspected to have focal areas of fat infiltration on ultrasound of the liver. An MRI of the liver is requested for further assessment. What sequences are most useful in confirming the diagnosis of focal fat infiltration?**

- A. T1WI pre and post gadolinium.
- B. T1WI and T2WI.
- C. T1WI and fat-saturated T2WI.
- D. Dual GET1WI in phase and out of phase.
- E. MR spectroscopy.

**25. D. Dual GET1WI in phase and out of phase.**

Three basic MRI techniques are available for fat detection, which work on the basis of the difference in precessional frequency between water and fat protons. These are chemical shift imaging, frequency-selective imaging, and MR spectroscopy. Dual GET1WI is the most useful sequence in clinical practice. It is based on the phase interference effect or chemical shift imaging of the second kind. When the fat and water protons are in phase there is constructive interference and when they are out of phase there is destructive interference. By comparing the signal intensities on the in-phase and out-of-phase images, fat detection is possible.

Chemical shift imaging of the first kind, or chemical shift spatial misregistration, occurs at fat–water interfaces in the frequency-encoding direction, manifesting as alternating bands of high and low signal. It is present in all standard non-fat-saturated sequences, but it can be subtle and may be missed or mistaken for image noise. Frequency-selective imaging with selective excitation or saturation depends on the homogeneity of the magnetic field and the size of the lesion.

MR spectroscopy is too time-consuming for routine clinical use.

**29. A 55-year-old female with cirrhosis undergoes MRI of the liver, which demonstrates multiple small nodules that are hypointense on T2WI and enhance following administration of gadolinium in the arterial and portal venous phase. The nodules demonstrate uptake of hepatocellular agent and super paramagnetic iron oxide (SPIO) particles. What is your diagnosis?**

- A. Multifocal hepatocellular carcinoma (HCC).
- B. Siderotic nodules.
- C. Dysplastic nodules.
- D. Regenerative nodules.
- E. Multiple arterio-venous shunts.

**29. D. Regenerative nodules.**

Regenerative nodules are formed in response to necrosis and altered circulation. They remain enhanced in the portal venous phase as opposed to HCC, which typically demonstrates contrast washout in the portal venous phase. Regenerative nodules have normal hepatocellular function and Kupffer cell density and therefore demonstrate uptake of both hepatocellular agents and SPIO particles. As dedifferentiation proceeds, the hepatocellular function and Kupffer cell density reduce.

**30. A 62-year-old male with acute myocardial infarction develops abdominal discomfort and deranged liver function tests. A CT scan of the abdomen demonstrates heterogeneous liver enhancement, poor enhancement of the hepatic veins and inferior vena cava (IVC), ascites and bibasal pleural effusions. What additional feature would favour a diagnosis of passive hepatic congestion instead of acute Budd–Chiari syndrome?**

- A. Flip-flop enhancement pattern of the liver.
- B. Absent flow in hepatic veins.
- C. Dilated hepatic veins and IVC.
- D. Enlarged caudate lobe.
- E. Hepatomegaly.



**30. C. Dilated hepatic veins and IVC.**

Elevated right atrial/central venous pressure due to cardiac decompensation results in impaired venous drainage from the liver, producing passive hepatic congestion. If prolonged, passive hepatic congestion can result in cardiac cirrhosis. On CT imaging, retrograde enhancement of dilated IVC and hepatic veins is seen in the arterial phase. In the portal venous phase, there is delayed/reduced enhancement of the hepatic veins due to impaired venous drainage. There is heterogeneous enhancement of the liver parenchyma due to venous stasis. Other features of cardiac failure may be evident.

Acute Budd–Chiari syndrome is characterized by narrowed hepatic veins and intrahepatic IVC (secondary to compression by the enlarged liver) and by flip-flop pattern of enhancement between the arterial and the portal venous phases.

**31. A 47-year-old male patient undergoes an MRI examination for further characterization of an adrenal lesion. Axial gradient T1 in- and out-of-phase sequences confirm the benign nature of the adrenal lesion. Incidentally, the liver and pancreas demonstrate a signal drop on the in-phase images compared to out-of-phase images. What is your diagnosis and what additional sequence would confirm the diagnosis?**

- A. Diffuse fatty infiltration. GE T2WI.
- B. Diffuse fatty infiltration. SE T2WI.
- C. Haemochromatosis. SE T2WI.
- D. Haemochromatosis. GE T2WI.
- E. Haemosiderosis. GE T2WI.
- F. Haemosiderosis. SE T2WI.

**31. D. Haemochromatosis. GE T2WI.**

A dual GE T1 in- and out-of-phase sequence is routinely used in identifying lipid content within an adrenal lesion. It is based on the phase interference effect. When the fat and water signals are in-phase, there is constructive interference and when they are out-of-phase there is destructive interference. This results in signal drop-off on the out-of-phase sequence.

The reverse effect of decreased signal intensity on in-phase images compared to out-of-phase ones is seen in iron deposition diseases. This is because the echo time for the in-phase sequence is longer than for the out-of-phase sequence, therefore the in-phase sequence is more susceptible to the paramagnetic (dephasing) effects of iron.

**Haemochromatosis** is an autosomal recessive genetic disorder. There is abnormal deposition of iron in parenchymal organs such as the liver, pancreas, heart, etc.

In **haemosiderosis or secondary haemochromatosis**, iron deposition is seen in the reticuloendothelial system of the liver, spleen, and bone marrow. This type of deposition is not associated with tissue damage.

A GET2 sequence demonstrates signal loss due to the magnetic field inhomogeneity produced by the paramagnetic effects of iron. GE sequences are more susceptible to the paramagnetic effects than SE sequences, as there is no  $180^\circ$  rephasing pulse in gradient sequences.

**37. A 50-year-old male undergoes MRI of the liver for further characterization of a suspected haemangioma on ultrasound. In addition to the haemangioma, a peripheral wedge-shaped area of enhancement is seen in the arterial phase but no abnormality is seen in the corresponding area in the non-contrast or portal venous phases. What is the diagnosis?**

- A. Hepatocellular carcinoma.
- B. Hepatic infarct.
- ☒ C. Transient hepatic intensity difference (THID).
- D. Hypervascular metastasis.
- E. Haemangioma.

**37. C. Transient hepatic intensity difference (THID).**

THID on MRI or transient hepatic attenuation difference (THAD) on CT is a pseudolesion caused by focal alteration in the haemodynamics of the liver due to either non-tumourous arterio-portal shunt or obstruction of distal portal venous flow. THID or THAD is seen as a focal area of enhancement in the arterial phase only, with no abnormality seen in the portal venous phase. Features suggestive of THID or THAD include peripheral location, wedge shape, straight margins, and normal vessels coursing through the area.



**51. A 50-year-old male patient is admitted with congestive cardiac failure and undergoes a CT scan of the abdomen, which shows tortuous and prominent intrahepatic and extrahepatic arterial branches with early filling of dilated hepatic veins and IVC. The arterial phase scan shows mosaic perfusion with multiple enhancing foci. In the portal venous phase there is homogenous enhancement of the liver, with the prominent hepatic veins and IVC noted. What is the diagnosis?**

- A. Passive hepatic congestion.
- B. Budd–Chiari syndrome.
- C. Osler–Weber–Rendu syndrome.
- D. Multifocal transient hepatic attenuation differences.
- E. Von Meyerburg complex.

**51. C. Osler–Weber–Rendu syndrome.**

Osler–Weber–Rendu syndrome or hereditary haemorrhagic telangiectasia (HHT) is a rare autosomal dominant multisystem vascular disorder characterized by angiodysplastic lesions in which there is communication between arteries and veins of varying sizes. It commonly affects the skin, lungs, and mucous membranes but any organ system may be involved.

The liver is the most common site of abdominal HHT. Lesions range from tiny telangiectases to transient perfusion abnormalities and large confluent vascular masses. Coronal maximum intensity projection (MIP) images are useful in appreciating telangiectases.

Liver involvement is associated with arterio-venous shunting, porto-venous shunting, or both, resulting in hyperdynamic circulation, which may lead to high-output cardiac failure.

Budd–Chiari syndrome is hepatic vein thrombosis and Von Meyerburg complex is multiple biliary hamartomas.

**65. You have been asked to give a presentation on MRI of the liver to your radiological colleagues. One of the audience asks if any of the contrast agents used in MRI of the liver works best with any sequence other than a T1WI sequence. What do you respond?**

- A. Yes, gadopentate dimeglumine.
- B. Yes, mangafodipir trisodium.
- C. Yes, gadobenate dimeglumine (hepatocyte specific).
- D. Yes, SPIO.
- E. No, all liver contrast agents work best with T1WI.



**65. D. Yes, SPIO.**

Gadolinium chelates are extracellular agents. Gadolinium shortens the T1 relaxation time of adjacent water protons, resulting in signal enhancement on T1WI. It can be used for lesion detection, characterization, and liver vasculature assessment. Gadopentate dimeglumine (Magnevist®) is a commonly used extracellular agent.

SPIO particles are reticulo-endothelial agents that are phagocytosed by Kupffer cells. SPIO causes local magnetic field inhomogeneity and T2 and T2\* shortening, resulting in signal loss on T2WI and T2\*WI. Most liver tumours, including HCC, are deficient in Kupffer cells (cf. focal nodular hyperplasia) therefore after administration of SPIO the tumour appears hyperintense relative to the background liver.

Mangafodipir trisodium (Teslascan®) is a manganese-based hepatocyte specific agent that increases the signal intensity of the liver, bile ducts, and some hepatocyte-containing lesions (e.g. FNH) at T1WI. Similarly, gadobenate dimeglumine (Multihance®) is a gadolinium-based hepatocyte specific agent, which also works best with T1WI due to the T1 shortening effects of gadolinium.

**70. A 55-year-old male liver transplant recipient undergoes Doppler ultrasound assessment at 1 year for deranged liver function tests. Colour Doppler imaging demonstrates a stenosis in the hepatic artery, at the presumed anastomosis. Which of the following statements with regard to the associated pulsed Doppler findings is likely to be false?**

- A. Tardus-parvus arterial waveform distal to the stenosis.
- B. Resistive index of 0.9 distal to the stenosis.
- C. Spectral broadening in the immediate post-stenotic portion.
- D. Elevated peak systolic velocity at the stenosis.
- E. Elevated end diastolic velocity at the stenosis.

**70. B.** Resistive index of 0.9 distal to the stenosis.

Knowledge of the vessel 'waveform signature' and stenosis flow dynamics is essential in interpreting the Doppler findings. The hepatic artery is a low resistance vessel with continuous antegrade flow during systole and diastole. Generally, low-resistance arteries have a resistive index (RI) of 0.55–0.7. RIs higher or lower than this range are abnormal. RI is calculated by using the formula  $RI = (\text{peak systolic velocity} - \text{end diastolic velocity}) / \text{peak systolic velocity}$ . Most modern ultrasound machines calculate this automatically.

A stenosis results in increased arterial resistance to the blood flow proximal to the stenosis. This causes a reduction in the end diastolic velocity disproportionately more than the peak systolic velocity, producing a high-resistance waveform and high RI (due to a greater difference between the peak systolic and end diastolic velocities). This finding is not specific to stenosis and may be seen in the postprandial state, and in patients of advanced age and diffuse peripheral microvascular disease or compression (cirrhosis, hepatic venous congestion, cold ischaemia, and any stage of transplant rejection).

At and immediately distal to the stenosis there is turbulent flow and a jet phenomenon resulting in an increase in the peak systolic and end diastolic velocity and spectral broadening. Depending on the severity of the stenosis, the artery distal to the stenosis demonstrates the following findings: tardus-parvus waveform that refers to the late and low systolic peak (i.e. increased acceleration time and reduced peak systolic velocity). Low RI due to a greater reduction in peak systolic velocity compared to the end diastolic velocity.

Low RI may also be seen with distal vascular shunts (trauma, iatrogenic, cirrhosis, Osler–Weber–Rendu syndrome).

**71. A 50-year-old male with a 2.5-cm hepatocellular carcinoma undergoes RFA. Which of the following findings is uncommon in the immediate post-ablation period?**

- A. Transient peri-ablational hyperaemia.
- B. Small number of tiny intra-lesional air bubbles.
- C. Arterio-portal shunting.
- D. Ablation zone larger than the primary lesion.
- E. 'Mural nodule in cyst' pattern.

**71. E. 'Mural nodule in cyst' pattern.**

RFA produces thermally-induced coagulation necrosis, which manifests usually as an oval or round defect on contrast-enhanced CT. The ablation zone is slightly larger than the actual lesion to achieve curative treatment and prevent local recurrence, which is usually seen at the margins of the ablation zone. The following findings are common in the immediate post ablation period: transient peri-ablational hyperaemia, tiny air bubbles, and arterio-portal shunting.

A 'mural nodule in cyst' indicates the development of a biloma as a complication of RFA. This is usually seen several months after treatment. It is associated with interval enlargement of the RFA zone.

- 5 ) A 47 year old man undergoes a CT and subsequently an MRI. These show an area of focal fat accumulation adjacent to the falciform ligament anteriorly.**

**This may be attributed to flow within which of the following?**

- (a) Vein of Sappey
- (b) Cholecystic vein
- (c) Right gastric vein
- (d) Anterior gastric vein
- (e) Inferior epigastric vein

**5 (a)**

This is a common aberrant vein which drains the superior epigastric vein and/ or the internal thoracic veins and communicates with the left portal vein branches.

**6** A 61 year old man has alcohol-related chronic liver disease. Which of the following conditions is he not at increased risk of developing compared with the general population?

- (a) Non-specific interstitial pneumonitis
- (b) Bacterial pneumonia
- (c) Hydrothorax
- (d) Pulmonary hypertension
- (e) Acute respiratory distress syndrome

**6 (a)**

There is no increased risk of NSIP or any other interstitial lung disease as a result of cirrhosis. Patients with cirrhosis have altered immunity and undergo changes to the vascular bed both within the liver and the lungs.

**17** An unenhanced CT of the liver is performed. The liver has a density of 60 HU and the spleen has a density of 50 HU.

How might you account for these findings?

- (a) Normal findings
- (b) Diffuse fatty infiltration
- (c) Haemochromatosis
- (d) Wilson's disease
- (e) Budd-Chiari syndrome

**17 (a)**

The normal liver has a density of 50–70 HU. Fatty infiltration will reduce this as the atomic numbers of the elements C, H and O are low. Iron and copper deposition can raise the density, as they have high atomic numbers.

- 19 A 50 year old man undergoes liver transplantation. A routine follow-up liver US comments that the intra-hepatic arterial Doppler has a low resistance index (0.48) and a prolonged systolic acceleration time.**

**What diagnosis does this suggest?**

- (a) Hepatic artery stenosis
- (b) Portal vein occlusion
- (c) Hepatic artery pseudoaneurysm
- (d) Graft rejection
- (e) Hepatic artery thrombosis

**19 (a)**

The tardus et parvus waveform described here is seen distal to a stenosis. At the stenosis, a jet phenomenon may be seen with greatly increased flow.

- 20 A patient with liver disease is referred for US assessment of their TIPS stent which has been in situ for 3 months. The Doppler study demonstrates a flow rate of 2.3 m/s.**

**What is this most likely to represent?**

- (a) Normal flow
- (b) Arterio-venous fistula
- (c) Stent stenosis
- (d) Stent fracture
- (e) Stent occlusion

**20 (c)**

This is a jet phenomenon at a narrow stenosis. Normal flow rates are 0.5-1.9m/s but may vary with respiration.



- 31 A patient is referred for the investigation of right upper quadrant pain. US has equivocal findings and a HIDA examination is requested. At 35 minutes, there is little uptake within the liver, but renal excretion is noted.

**What is the most likely cause for these findings?**

- (a) Poor liver function
- (b) Acute cholecystitis
- (c) Poor renal function
- (d) Sphincter of Oddi dysfunction
- (e) Chronic cholecystitis

**31 (a)**

Liver uptake should be seen within 10 minutes. Thereafter, there is filling of the gallbladder and subsequent excretion to the bowel. Cholecystitis impairs uptake to the GB.

- 39 Hepatocellular adenomas are not associated with which of the following?

- (a) Spontaneous rupture
- (b) Oral contraceptive pill
- (c) Hepatocellular carcinoma
- (d) Androgenic steroids
- (e) Cholangiocarcinoma

**39 (e)**

Hepatocellular adenomas are uncommon benign tumours which comprise hepatocytes with no portal tracts or bile ducts. They are associated with the oral contraceptive pill and androgenic steroids. On imaging, they may have a scar or a pseudocapsule and enhance avidly in the arterial phase which can make differentiation from FNH difficult. There is a tendency to bleed or rupture, whilst 1% are thought to transform in to malignant lesions (HCC).

- 48 A 28 year old man with cystic fibrosis and abnormal liver function is referred to you for liver imaging by his clinical team.**

**Which of the following are not associated with cystic fibrosis?**

- (a) Nodular regenerative hyperplasia
- (b) Steatosis
- (c) Sclerosing cholangitis
- (d) Cirrhosis
- (e) Cholelithiasis

**48 (a)**

Cystic fibrosis produces a range of abnormalities, which may lead to fibrosis, cirrhosis and portal hypertension. A micro-gallbladder is also seen commonly.

- 2 A 42 year old woman presents with acute right upper quadrant pain and abdominal distension. She has a 1-week history of dark urine, particularly in the mornings, and is found to have pancytopenia.**

**What is the most likely diagnosis?**

- (a) Acute cholecystitis
- (b) Acute pyelonephritis
- (c) Budd-Chiari syndrome
- (d) Ruptured renal cell carcinoma
- (e) Infectious mononucleosis

**2 (c)**

The patient has classical features of underlying paroxysmal nocturnal haemoglobinuria (PNH), which predisposes to Budd-Chiari syndrome. Budd-Chiari syndrome presents with these symptoms; the severity of the initial liver disease is variable depending upon the extent of venous occlusion.

- 3 An MRI liver report reads: "There is a hyperintense lesion on T2-weighted imaging, which is hypointense on T1-weighted images. Following administration of *i.v.* Gadolinium, there is peripheral nodular enhancement in the arterial phase with progressive enhancement on the portal venous and delayed phases."

**What is the most likely diagnosis?**

- (a) Haemangioma
- (b) Cyst
- (c) Focal nodular hyperplasia
- (d) Hepatocellular adenoma
- (e) Hepatocellular carcinoma

3 (a)

These are characteristic findings of a haemangioma. A cyst will not enhance; FNH and adenoma are benign hypervascular lesions that equilibrate in the portal phase. HCC is hypervascular with washout on delayed imaging; the liver is usually cirrhotic.

- 13 A 33 year old woman undergoes an MRI study to characterise a 4 cm focal liver lesion found incidentally on US. The lesion is isointense to liver on T1 and T2-weighted images, enhances homogeneously and avidly in the arterial phase and is isointense in the portal venous and delayed phases. 1 hour after the administration of contrast medium (Gd-Bopta), the lesion is hyperintense to liver.

**What is the most likely diagnosis?**

- (a) Haemangioma
- (b) Focal nodular hyperplasia
- (c) Hepatocellular adenoma
- (d) Fibrolamellar hepatocellular carcinoma
- (e) Metastasis

**13 (b)**

These imaging features are characteristic of FNH. FNH is a benign tumour thought to represent a hyperplastic response to a pre-existing arterial malformation. It is most commonly seen in women and has no malignant potential. A central scar may be seen which shows delayed enhancement.

- 14 A 52 year woman with a history of atrial fibrillation and rheumatoid arthritis presents with right-sided renal colic. On the unenhanced CT study there is diffuse low density in the liver.**

**Which of the following might account for this appearance?**

- (a) Amyloidosis
- (b) Amiodarone therapy
- (c) Haemochromatosis
- (d) Haemosiderosis
- (e) Wilson's disease

**14 (a)**

The most common cause of diffuse low attenuation is fatty infiltration; amyloidosis is another due to amyloid deposition. Amyloidosis can be a primary condition, or secondary to chronic infectious, chronic inflammatory disease (e.g. rheumatoid arthritis), or multiple myeloma. Answers (b) – (d) increase copper/iron deposition within the liver, which will lead to increased liver density on a pre-contrast CT.

- 16** A 47-year old man presents with atypical RIF pain; a CT abdomen is requested to rule out appendicitis. No cause for abdominal pain is identified. The only finding of note is an 8 mm low-attenuation lesion within the left lobe of the liver. The lesion lies inferior to the portal vein and lateral to the left hepatic vein.

**What segment of the liver is the lesion in?**

- (a) Segment I
- (b) Segment II
- (c) Segment III
- (d) Segment IV-A
- (e) Segment IV-B

**16 (c)**

The Couinaud classification divides the liver into 8 functionally independent segments, each with its own blood supply and biliary drainage. The portal vein divides the liver into superior and inferior segments. The middle hepatic vein divides the left (segments I-IV) and right lobes (segments V-VIII). The right hepatic vein divides the right lobe into anterior (V and VIII) and posterior (VI and VII) segments. The left hepatic vein divides the left lobe into medial (segments IV-A and IV-B) and lateral part (segments II and III); segment I is the caudate lobe, situated posteriorly.



- 19** A patient is referred for chemo-embolisation of a hepatocellular carcinoma in the right lobe of the liver. The initial angiogram demonstrates that the lesion is supplied from the superior mesenteric artery.

**What proportion of patients have an arterial supply to liver from the SMA?**

- (a) 7%
- (b) 14%
- (c) 17%
- (d) 21%
- (e) 25%

**19 (e)**

14% of patients have an accessory right hepatic artery, 7% have a replaced right hepatic artery and 4% have a totally replaced hepatic artery arising from the SMA.

- 24** A 52 year old lady undergoes liver transplantation for autoimmune liver disease. 6 months later, she presents with deranged liver function and an MRCP demonstrates a non-anastamotic stricture.

**What is the most common aetiology of non-anastamotic strictures in this group?**

- (a) Ischaemia
- (b) Rejection
- (c) Recurrent autoimmune liver disease
- (d) Biliary cast syndrome
- (e) Post-transplantation lymphoproliferative disease

**24 (a)**

Ischaemia is the underlying cause in approximately 50% of cases; the bile ducts are supplied by the hepatic artery and their blood supply is inevitably disrupted to some extent during transplantation. Evaluation of the hepatic arterial supply to the graft is crucial as thrombosis usually requires re-transplantation in the adult population.

**26 A 56 year old woman is referred for an US of the liver which shows a solitary 3 cm hypoechoic lesion. US contrast is given which demonstrates the lesion to be hyporefective with rim enhancement. The rim enhancement fades in the portal venous phase and the lesion becomes increasingly hyporefective and well-defined.**

**What is the most likely diagnosis?**

- (a) Cyst
- (b) Haemangioma
- (c) Focal nodular hyperplasia
- (d) Hepatocellular carcinoma
- (e) Metastasis

**26 (e)**

These are the characteristic features of a hypovascular metastasis. Lesions enhance in a fashion similar to that seen on CT or MRI.

- 27 A 47 year old man with multifocal hepatocellular carcinoma and chronic liver disease is referred for consideration of liver transplantation.**

**Which of the following would be considered for transplantation in the UK?**

- (a) 2 lesions measuring 5 cm or less
- (b) 2 lesions measuring 4 cm or less
- (c) 3 lesions measuring 3 cm or less
- (d) 4 lesions measuring 2 cm or less
- (e) 5 lesions measuring 2 cm or less

**27 (c)**

Transplantation is considered in patients with 1 lesion <5 cm or up to 3 lesions measuring 3 cm or less, the 'Milan Criteria'.

- 41 You are referred a patient with a history of previous left hepatectomy. What liver segments will have been resected?**

- (a) I & II
- (b) II & III
- (c) I, II & III
- (d) II, III & IV
- (e) I, II, III & IV

**41 (b)**

These segments are also referred to as the left lateral lobe. Resection of Segment IV also is termed an extended left hepatectomy. Resection of V, VI, VII and VIII is a right hepatectomy; an extended right hepatectomy includes segment IV also. The caudate lobe is usually only resected during liver transplantation.

**46 With regard to non-alcoholic steato-hepatitis (NASH), which of the following statements is not true?**

- (a) It is seen in up to 30% of the population
- (b) Diabetes mellitus is a risk factor
- (c) Up to 15% of patients progress
- (d) Is associated with hepatic fibrosis
- (e) May resolve with dietary modifications alone

**46 (a)**

Hepatic steatosis is seen in this proportion of the population; of these, 6-8% progress to NASH, where there is inflammation of the hepatocytes and abnormal liver function.

**58 A 48 year old man with diabetes mellitus and abnormal liver function undergoes an MRI of the liver. The liver parenchyma has a smooth contour and is relatively hypointense on the T1-weighted image and hypointense to muscle on the T2-weighted image.**

**What is the most likely diagnosis?**

- (a) Acute hepatitis
- (b) Fatty liver
- (c) Haemochromatosis
- (d) Autoimmune liver disease
- (e) Wilson's disease

**58 (c)**

The low signal within the liver parenchyma on T2-weighted images is due to the susceptibility artefact from iron overload. Patients with haemochromatosis deposit iron within the skin, heart, liver and pancreas. This degree of iron within the liver can be quantified using MRI.

- 59 A previously well 56 year old man presents with right upper quadrant pain and tenderness associated with nausea and vomiting. A liver US demonstrates the presence of a large cyst containing a number of smaller cysts with a honeycomb appearance.**

**What is the most likely diagnosis?**

- (a) Cystadenoma
- (b) Cholangiocarcinoma
- (c) Hydatid cyst
- (d) Hepatocellular carcinoma
- (e) Caroli disease

**59 (c)**

Hydatid infection is caused by *Echinococcus multilocularis*, and may give rise to a number of appearances at US with cysts being uni- or multi-loculated, thin or thick-walled, with or without calcification. The appearance described here is referred to as daughter cysts. Cystadenoma gives rise to a large unilocular cyst or septated cyst. Caroli disease is due to duct abnormalities; hepatocellular carcinoma and cholangiocarcinoma are solid lesions.

- 60 Which of the following is not a recognised association of polycystic liver disease?**

- (a) Non-Hodgkin lymphoma
- (b) Haemorrhage
- (c) Portal hypertension
- (d) Infection
- (e) Polycystic kidney disease



**60 (a)**

Polycystic liver disease is a hereditary condition that may or may not be associated with polycystic kidney disease. There is no malignant potential within the cysts but complications may arise from the sheer size of the cysts, and therapeutic interventions. Aspiration, fenestration and enucleation may provide short term relief, but some cases will require repeated therapy or transplantation.

**63 Which of the following conditions is not associated with nodular regenerative hyperplasia?**

- (a) Polycythaemia rubra vera
- (b) Rheumatoid arthritis
- (c) Cirrhosis
- (d) Systemic lupus erythematosus
- (e) Non-Hodgkin's lymphoma

**63 (c)**

NRH is diffuse nodularity of the liver produced by regenerative nodules in the absence of hepatic fibrosis. Although a rare entity, it is commonly associated with portal hypertension (50% cases).

9) A 34-year-old man presents with acute left lower quadrant pain following unaccustomed exercise. CT of the abdomen demonstrates a 2.5 cm oval lesion with attenuation value of -60 HU abutting the sigmoid colon, with surrounding inflammatory changes. The sigmoid colon itself appears normal. What is the most likely diagnosis?

- a. omental infarction
- b. diverticulitis
- c. epiploic appendagitis
- d. liposarcoma
- e. appendicitis

9) c. \*\*\*\*

Acute epiploic appendagitis is thought to result from torsion of one of the fatty epiploic appendages arising from the serosal surface of the colon. It usually occurs in young men, presenting as acute lower quadrant pain, and is associated with obesity and unaccustomed exercise. Typical CT findings are of an oval pericolic fat density lesion of <5 cm, with surrounding inflammatory changes, most commonly in the sigmoid, descending or right hemicolon. Right-sided epiploic appendagitis may be mistaken clinically for appendicitis. Omental infarction typically appears as a larger, heterogeneous lesion, usually affecting the caecum or ascending colon. Acute diverticulitis usually occurs in older patients, and is associated with colonic diverticula and wall thickening. Liposarcoma is rare, but is included in the differential of a fat-containing intra-abdominal mass.

14) A 47-year-old woman presents with progressive abdominal distension. CT of the abdomen demonstrates loculated collections of very low-attenuation fluid in the peritoneal cavity containing scattered curvilinear calcifications, and a scalloped contour to the liver. What is the most likely diagnosis?

- a. pancreatic pseudocysts
- b. ascites due to liver cirrhosis with portal hypertension
- c. peritoneal metastases
- d. pseudomyxoma peritonei
- e. peritoneal mesothelioma

14) d. \*\*\*\*

Pseudomyxoma peritonei results from rupture of a benign or malignant mucin-producing tumour, most commonly of the appendix or ovary, but also of the pancreas, stomach and colon. Typical findings are of large-volume mucinous ascites, which appears on CT as very low-attenuation (mucinous) fluid collections in the omentum, mesentery and peritoneal cavity, often loculated and containing curvilinear or punctuate calcifications. A characteristic feature is scalloping of the contour of the liver and splenic margins, which distinguishes mucinous from serous ascites. Peritoneal metastases may also demonstrate loculated peritoneal fluid collections, but there are typically nodular peritoneal densities and thickening of the greater omentum (omental cake). Peritoneal mesothelioma usually presents with thickened mesentery, omentum, peritoneum and bowel wall, with a disproportionately small amount of ascites.

5. A 40 year old man is admitted to the surgical ward with acute abdominal pain and subsequently a CT abdomen and pelvis is requested. The findings include a 3 cm oval mass with central fat density adjacent to the sigmoid colon and with associated fat stranding. Which one of the following is the most likely diagnosis?
- a. Diverticulitis
  - b. Epiploic appendagitis
  - c. Mesenteric lymphadenitis
  - d. Meckel's diverticulitis
  - e. Infected enteric duplication cyst

5. b. Epiploic appendagitis

Epiploic appendagitis is inflammation of one of the epiploic appendages of the colon, with the sigmoid being the commonest site. It typically presents with acute abdominal pain and is an important radiological diagnosis as it can often mimic appendicitis, and management is conservative. The diagnosis is usually made on CT with the features described in the question. Ultrasound is rarely used for diagnosis, and features include a non-compressible hyperechoic mass with hypoechoic margins.

- 13.) A 71 year old man is referred to CT for unexplained abdominal distension. Low-attenuation intraperitoneal collections with enhancing septae are demonstrated. There is scalloping of the liver border and omental thickening. Which one of the following is most likely to be the underlying cause?
- a. Carcinoid tumour of the appendix
  - b. Cystadenocarcinoma of the appendix
  - c. Melanosis coli
  - d. Mastocytosis
  - e. Retroperitoneal fibrosis

**13. b. Cystadenocarcinoma of the appendix**

The CT findings described are consistent with pseudomyxoma peritonei. This describes abdominal distension secondary to the accumulation of large quantities of gelatinous ascites. It is most commonly caused by cystadenocarcinoma of the appendix in males and cystadenocarcinoma of the ovary in females. Surgical debulking and intraperitoneal chemotherapy may be offered as a treatment. Bowel obstruction is a frequent complication that may necessitate surgery.

40. A 50 year old female presents to A&E with acute abdominal pain. On examination there is point tenderness over an area in the right iliac fossa. CT reveals a well-defined triangular area of high-attenuation fat density anteriorly in the lower right abdomen. The large and small bowel are normal. Which one of the following is most likely?

- a. Segmental omental infarction
- b. Rectus haematoma
- c. Epiploic appendagitis
- d. Carcinoid tumour
- e. Mesenteric vein thrombosis

**40. a. Segmental omental infarction**

Segmental omental infarction is the most likely cause and most commonly affects the right half of the greater omentum. It mimics surgical pathology such as appendicitis. High-attenuation streaks in the omental fat with apparent 'mass effect' in the absence of any other findings is suggestive of the diagnosis. Point tenderness over the specific area of CT abnormality is often discovered. Management is conservative.



46. A 48 year old male presents with abdominal pain, nausea and weight loss. Contrast-enhanced CT of the abdomen and pelvis reveals a heterogeneous, well-defined fatty mass at the root of the small bowel mesentery. The mesenteric vessels are surrounded but not distorted by the mass, and the vessels are surrounded by an apparent low-attenuation halo. The small bowel and right colon are normal. Which is the most likely diagnosis?
- a. Tuberculosis
  - b. Mesenteric lymphadenitis
  - ☒ c. Mesenteric panniculitis
  - d. Radiation enteritis
  - e. Mesenteric lipoma

46. c. Mesenteric panniculitis

These CT findings are typical of mesenteric panniculitis. This is an idiopathic, indolent condition characterised by inflammation of the small bowel mesentery adipose tissue. Fibrosis can predominate, in which case the CT appearances are of an infiltrative soft-tissue mass with soft-tissue density strands radiating away from it. In this situation it has similar appearance to lymphoma, carcinoid or desmoid tumours or retroperitoneal fibrosis, and biopsy is required to differentiate. Mesenteric panniculitis often presents with non-specific symptoms such as abdominal pain, weight loss, nausea, vomiting and pyrexia, and is usually indolent and self-limiting.

- 4 A 40-year-old patient presented with right-sided lower abdominal pain. A CT was performed which showed a small pedunculated oval-shaped mass of -60 HU with a more dense peripheral rim and fat stranding adjacent to the proximal descending colon. What is the most likely diagnosis?
- a Acute appendicitis
  - b Perforated appendix with abscess
  - c Epiploic appendagitis
  - d Appendiceal tumour
  - e Diverticulitis

4 Answer C: Epiploic appendagitis

Epiploic appendagitis (EA) is uncommon and is due to inflammation of one of the 100 or so epiploic/omental appendages that arise from the serosal surface of the colon. Histology shows acute infarction with fat necrosis, inflammation and thrombosed vessels with haemorrhagic suffusion, but if recognised on CT it can usually be treated conservatively with spontaneous resolution within two weeks. CT appearances resolve by six months. The typical patient is a male in their forties.

- 23 A patient presents for review following a CT of their abdomen and pelvis in another centre. The images have not been transferred but the report describes an enhancing submucosal mass in the ileum with associated changes in the mesentery. The report continues describing a stellate radiating pattern and beading of the mesenteric neurovascular bundles with retraction of the mesentery and thickening of the wall of the subtended loops of bowel. Assuming the report is accurate, what is the most likely diagnosis?

- a Lymphoma
- b Metastatic gastric carcinoma
- c Carcinoid tumour
- d Mesenteric panniculitis
- e Gardner's syndrome

23 Answer C: Carcinoid tumour

This is a description of retractile mesenteritis and is associated with all the listed conditions. However, the enhancing submucosal lesion in the ileum is a classic appearance and site of a carcinoid tumour.

- 26 A 65-year-old woman was investigated for recurrent diarrhoea. Her husband reported that she also became flushed and slightly short of breath after meals. Carcinoid syndrome was suspected and she was referred for an abdominal CT and small bowel MRI study. What feature is most typical of small bowel carcinoid?
- a Duodenal location
  - b Calcified lymphadenopathy
  - c Mesenteric mass
  - d Minimal desmoplastic reaction
  - e Free fluid

26 Answer C: Mesenteric mass

- 69 An obese 55-year-old female had a history of abdominal bloating, but no other symptom was investigated. Plain chest and abdominal radiographs were normal. An ultrasound showed a moderate amount of ascites, but the views were limited and a contrast-enhanced CT was arranged which showed gross abdominal ascites with a mean density of 45 HU. No other abnormality was detected. What is most likely to have caused the ascites?
- a Budd-Chiari syndrome
  - b Hypoalbuminaemia
  - c Meigs syndrome
  - d Right heart failure
  - e Unseen ovarian tumour

69 Answer E: Unseen ovarian tumour

The three classical causes of high-density ascites are tuberculosis, ovarian tumour and appendiceal tumour, which produce particularly proteinaceous fluid. Other exudates may also cause ascites of higher density: Meigs syndrome is an exudative process, but no pleural effusion was present. A simple transudate is likely to be of lower attenuation, for example Budd-Chiari syndrome.

44. A 67-year-old man presents to A&E with abdominal pain. Inflammatory markers are raised, but serum electrolytes, amylase, haemoglobin, and coagulation are normal. He takes no regular medication. On examination, there is a palpable mass in the right lower quadrant. CT reveals a lobulated, hypoattenuating mass with thick walls, septa, and curvilinear calcifications. It is located in the RIF, and displaces and distorts the adjacent psoas muscle. What is the most likely diagnosis?

- A. Pancreatic pseudocyst.
- B. Pseudomyxoma retroperitonei.
- C. Urinoma.
- D. Haematoma.
- E. Retroperitoneal liposarcoma.

44. B. Pseudomyxoma retroperitonei.

The displacement of the psoas muscle indicates that this mass is most likely retroperitoneal. Pseudomyxoma peritonei is a rare condition that is characterized by intraperitoneal accumulation of gelatinous material owing to the rupture of a mucinous lesion of the appendix or ovary, e.g. mucinous cystadenoma/cystadenocarcinoma. It may occur in the retroperitoneum, where it is caused by the rupture of a mucinous lesion in the retrocaecal appendix and fixation of the lesion to the posterior abdominal wall. Clinically, it results in abdominal pain and a palpable mass. At CT, it appears as a multicystic mass with thick walls or septa that displace and distort adjacent structures. Curvilinear or punctuate mural calcifications may also occur and are highly suggestive. Pancreatic pseudocysts usually occur in the peripancreatic space, but may occur in the abdomen, pelvis, or mediastinum. They are associated with the clinical findings of pancreatitis and elevation of serum amylase.

A urinoma is an encapsulated collection of chronically extravasated urine. There is usually a history of trauma and an associated hydronephrosis.

Haematomas are associated with trauma, coagulopathy/anticoagulants, or a ruptured abdominal aortic aneurysm. Chronic haematoma can result in low attenuation contents, but acutely the haematoma will have higher attenuation than pure fluid due to clot formation.

Retroperitoneal liposarcoma is most commonly of a density between water and muscle (myxoid type). It may have a solid, mixed, or pseudocystic pattern on CT. There may also be macroscopic areas of lipid in well-differentiated liposarcomas. Patients present with abdominal pain, weight loss, a palpable mass, and anaemia.

**47. A 54-year-old man presents with persistent abdominal pain and fever. His amylase has been normal, and colonoscopy and small bowel series were unremarkable during previous investigation. He has a past medical history of thyroid disease. A CT of abdomen reveals ill-defined rounded areas in the root of the mesentery, with adjacent mild lymphadenopathy. There is some central calcification. A rim of preserved fat is seen surrounding the adjacent vessels. What is the most likely diagnosis?**

- A. Sclerosing mesenteritis.
- B. Desmoid tumour.
- C. Carcinoid tumour.
- D. Lymphoma.
- E. Metastatic disease.

**47.A.** Sclerosing mesenteritis.

This is a rare condition of unknown cause characterized by chronic mesenteric inflammation. It is most frequently seen in the sixth decade and more commonly in males than females. It is often associated with other inflammatory disorders such as retroperitoneal fibrosis, Riedel thyroiditis, and sclerosing cholangitis. Symptoms include abdominal pain, nausea, fever, intestinal obstruction or ischaemia, a mass, or diarrhoea. The CT findings can range from subtle increased attenuation in the mesentery to a solid soft-tissue mass. The mass may envelop vessels, but there may be preservation of fat around the vessels, the 'fat halo' sign. This finding may help distinguish sclerosing mesenteritis from other mesenteric processes such as lymphoma, carcinomatosis, or carcinoid tumour. Calcification may be present, usually in the central necrotic portion. Enlarged mesenteric or retroperitoneal lymph nodes may also be present.

Lymphoma will not display calcification unless it has undergone treatment. Carcinoid can produce the appearance described, but the 'fat halo' sign favours sclerosing mesenteritis and the soft tissue in carcinoid usually has a surrounding desmoplastic reaction. Metastatic disease will not be confined to the root of the mesentery, but will also involve the omentum or the surfaces of the liver, spleen, or bowel. Ascites is also common with carcinomatosis, but is not associated with sclerosing mesenteritis. Mesenteric involvement in the case of desmoid tumours is more often seen in cases related to familial adenomatous polyposis syndrome or Gardner syndrome. They are usually large masses, measuring 15 cm or more at diagnosis. They do not typically contain calcification.



**50. An overweight 42-year-old man decides to join a gym as a New Year's resolution. During a vigorous work-out, he develops acute left lower quadrant pain and tenderness. An initial ultrasound demonstrates a small, 2-cm solid hyperechoic, non-compressible oval mass at the site of maximal tenderness. Further investigation via CT shows a pericolic pedunculated mass with fat attenuation and a hyperattenuating peripheral rim with adjacent fat-stranding abutting the anterior sigmoid colon. What is the most likely diagnosis?**

- A. Diverticulitis.
- B. Appendicitis.
- C. Epiploic appendagitis.
- D. Omental infarction.
- E. Sclerosing mesenteritis.

**50. C. Epiploic appendagitis.**

Acute epiploic appendagitis is a self-limiting inflammation of the appendices epiploicae, associated with obesity, hernia, and unaccustomed exercise. Omental infarction typically presents with pain of several days' duration. CT demonstrates a large non-enhancing omental mass with heterogenous attenuation, and is typically located towards the right lower quadrant. Sclerosing mesenteritis is commonly located at the root of the small bowel mesentery.

**54. A 55-year-old man with a previous history of liver transplantation presents with a 1-week history of abdominal pain and distension. An AXR shows some distended small bowel loops centrally within the abdomen. You are asked to perform a CT scan of abdomen for further evaluation. This shows a cluster of non-encapsulated dilated small bowel loops adjacent to the anterior abdominal wall on the right side. There are adjacent crowded mesenteric vessels. What is the most likely diagnosis?**

- A. Small bowel adhesions.
- B. Left paraduodenal hernia.
- C. Right paraduodenal hernia.
- D. Foramen of Winslow hernia.
- E. Transmesenteric hernia.

**54. E. Transmesenteric hernia.**

This is when small bowel herniates through a defect in the mesentery and is compressed against the abdominal wall, with little overlying omental fat at most levels of anatomic section through the herniated bowel. There will be some degree of compression, crowding, displacement, and obstruction of both the bowel and blood vessels. They are usually seen in association with previous abdominal surgery and the creation of a Roux-en-Y anastomosis, when the hernia occurs in a surgically created defect in the mesentery.

A left-sided paraduodenal hernia is via the paraduodenal (lateral to the fourth part) mesenteric fossa of Landzert, close to the ligament of Treitz. The characteristic features include a sac-like mass of dilated bowel lateral to the ligament of Treitz, which displaces and indents the adjacent stomach and transverse colon.

A right paraduodenal hernia occurs via the jejunal mesentericoparietal fossa of Waldeyer. A cluster of dilated small bowel loops is seen lateral and inferior to the descending duodenum.

**58. A 45-year-old man, with a history of AIDS, has a 3-month history of abdominal pain and weight loss. A CT scan of abdomen is performed which shows ascites with peritoneal thickening, several areas of mural thickening in the small bowel, and multiple low attenuation lymph nodes. Which one of the following infections is most likely?**

- A. CMV infection.
- ☒ B. TB.
- C. Cryptosporidiosis.
- D. Amoebiasis.
- E. Campylobacter.



**58. B. TB.**

Cryptosporidiosis is the most common cause of enteritis in AIDS patients. It more commonly causes proximal small bowel thickening in the duodenum and jejunum, and CT may show small lymph nodes. CMV infection of the small bowel can show a terminal ileitis indistinguishable from Crohn's disease. The typical CT findings in amoebiasis are thickening of the right colonic wall and a rounded abscess in the right lobe of liver with a peripheral zone of oedema. TB usually shows ileocaecal involvement, low attenuation mesenteric nodes, and ascites with peritoneal thickening. Mycobacterium avium intracellulare may also occur with low attenuation mesenteric nodes and thickening of small bowel folds.

**68. A 26-year-old man, with a previous history of a panprocto-colectomy for Gardner's syndrome, presents with vague abdominal discomfort and a CT scan is requested to ascertain the cause. He is found to have a well-defined mass of homogenous density, which you suspect may be a desmoid tumour, given the previous clinical history. Where in the abdomen is this most likely to be located?**

- A. Abdominal wall.
- B. Retroperitoneum.
- C. Small bowel mesentery.
- D. Pelvis.
- E. Duodenal wall.

**68. C. Small bowel mesentery.**

Desmoid tumours are non-malignant fibrous tumours that have a particular association with FAP/Gardner syndrome. They may be locally infiltrative. On CT they are usually of homogeneous density, but can have well-defined or irregular margins. On MRI, the signal intensity on T1WI is similar to muscle and on T2WI their signal can be variable. Lower signal tumours on T2WI probably have a denser fibrous component. Desmoid tumours in association with FAP/Gardner syndrome are most commonly seen in the small bowel mesentery, followed by the abdominal wall. Intra-abdominal desmoid tumours can also occur in the retroperitoneum and pelvis, but these locations are more common in isolated desmoids.

**16 A 77 year old man presents with abdominal distension. A CT study of his abdomen and pelvis reveals nodular peritoneal thickening, omental cake and a stellate appearance within the mesentery. Some foci of calcification are evident.**

**What is the most likely diagnosis?**

- (a) Tuberculosis
- (b) Lymphoma
- (c) Carcinoma
- (d) Pseudomyxoma
- (e) Mesothelioma



**16 (e)**

These are the typical features of sarcomatous mesothelioma. Peritoneal mesothelioma represents 6–10% cases of mesothelioma, with 50% cases having had previous asbestos exposure. Radiation therapy also predisposes to this condition, which affects visceral and parietal peritoneum.

- 6 A 40 year old man presents with acute left iliac fossa pain. He is afebrile and the WCC is normal. CT demonstrates a 2.5 cm ovoid lesion with surrounding fat stranding arising from the anterior wall of the sigmoid colon. The lesion enhances peripherally and has a central attenuation of –50 HU. There is no associated thickening of the colonic wall.**

**What is the most likely diagnosis?**

- (a) Diverticulitis
- (b) Epiploic appendagitis
- (c) Mesenteric panniculitis
- (d) Omental infarct
- (e) Sclerosing mesenteritis

**6 (b)**

Epiploic appendages are peritoneal fat outpouchings that arise from the serosal surface of the colon, attached by vascular stalks (supplied by 1-2 small end-arteries and a draining vein). They contain adipose tissue and vessels, and measure up to 5 cm (typically 1–2 cm). Epiploic appendagitis is inflammation secondary to torsion or venous occlusion. The most common location is anterior to the sigmoid colon, there is surrounding fat stranding, and a low-density (fat) centre is seen; associated colon thickening is rare. Omental infarction can appear similar, but lacks the hyperdense ring enhancement and is more typically seen as an oval soft-tissue mass in the right lower quadrant, deep to the anterior abdominal muscles.

- 49 A 56 year old lady with upper abdominal pain is referred for a CT of the abdomen and pelvis. This shows an abnormal loop of small bowel passing between the portal vein and IVC.**

**What type of internal hernia is this?**

- (a) Foramen of Winslow
- (b) Left paraduodenal
- (c) Transmesenteric
- (d) Right paraduodenal
- (e) Inter-sigmoid

**49 (a)**

The loop of bowel passes through the foramen of Winslow in to the lesser sac. Left paraduodenal hernias pass through a defect in the descending mesocolon and lie to the left of the 4th part of the duodenum; the rarer right paraduodenal hernia passes behind the SMA and is associated with malrotation. Transmesenteric hernias are commoner following surgery.

- 67 A 78 year old lady presents to A&E with small bowel obstruction. A CT study demonstrates the transition point to be a loop of small bowel lying immediately behind the pectineus muscle.**

**What is the diagnosis?**

- (a) Perineal hernia
- (b) Sciatic hernia
- (c) Inferior lumbar triangle hernia
- (d) Femoral hernia
- (e) Obturator hernia

**67 (e)**

The pectineus muscle is the anterior border of the obturator canal, with the obturator externus the posterior margin. Bowel is commonly obstructed with this type of hernia, often seen in elderly patients.





- 42) A 64-year-old woman presents with jaundice. An abdominal ultrasound scan demonstrates the intrahepatic biliary ducts to be of similar calibre to the adjacent portal veins. The extrahepatic common bile duct measures 5 mm in diameter. No gallstones are seen. What is the most appropriate further imaging investigation?
- a. CT of the abdomen
  - b. endoscopic ultrasound scan
  - c. MRCP
  - d. ERCP
  - e. no imaging indicated as normal findings

42) c. \*\*\*\*

Intrahepatic bile ducts are considered dilated when they exceed 40% of the diameter of the adjacent portal veins. The upper limit of normal for the extrahepatic common bile duct is 5 mm in adults (increasing after age 60 by approximately 1 mm/decade). Appearances here are indicative of biliary obstruction at the level of the hilum, and MRCP is the investigation of choice after ultrasound scan in these circumstances. MRCP reliably demonstrates the extent of ductal involvement, allowing planning of surgery or treatment; with malignant causes, it may provide further staging information. CT is the investigation of choice when ultrasound scan indicates obstruction below the hilum. If ultrasound scan demonstrates ductal stones, ERCP is the investigation of choice for confirmation and therapeutic intervention. Endoscopic ultrasound scan is particularly useful for detecting small ductal stones and periampullary tumours. Percutaneous transhepatic cholangiography is reserved for cases when ERCP is not possible.

- 47) A 40-year-old woman undergoes abdominal ultrasound scan, which demonstrates three small, rounded, echogenic structures in relation to the anterior wall of the gallbladder. There is no posterior acoustic shadowing, and appearances remain constant with variation in patient position. The remainder of the gallbladder and biliary tree appear unremarkable. What is the most likely diagnosis?
- a. gallstones
  - b. cholesterol polyps
  - c. adenomyomatosis
  - d. gallbladder carcinoma
  - e. strawberry gallbladder

Cholesterosis is a form of hyperplastic cholecystosis in which triglycerides, cholesterol precursors and cholesterol esters accumulate within the lamina propria of the gallbladder wall. Most cases are of the planar type, termed 'strawberry gallbladder' after the resemblance of the gallbladder mucosa to the surface of a strawberry, and produce no detectable ultrasound changes. In a minority of cases, **cholesterol polyps are formed, which are the commonest type of gallbladder polyp.** They are generally small, multiple echogenic lesions adjacent to the gallbladder wall. Non-mobility and a lack of posterior acoustic shadowing helps to distinguish polyps from gallstones. **Small size and multiplicity distinguishes them from gallbladder malignancy, though, rarely, metastatic disease may produce multiple polypoid lesions, particularly malignant melanoma. Adenomyomatosis, the other form of hyperplastic cholecystosis, results in mucosal hyperplasia and thickening of the muscular layer of the gallbladder. It is characterized by bright reflections and comet-tail artefacts from the gallbladder wall on ultrasound scan.**

(2007), 750.

Cholesterol polyps  $\Rightarrow$  multiple, small, non-shadowing lesions  
Lesion  $> 10\text{mm}$  with atypical features (sessile, singularity, internal vascularity)  $\Rightarrow$  further evaluation with CECT or surgery (malignant risk)  
no doppler signal



49) A 36-year-old man with ulcerative colitis develops progressive jaundice and pruritis. CT of the abdomen demonstrates multiple areas of dilatation and stenosis of tortuous intrahepatic bile ducts, with wall thickening and contrast enhancement of the extrahepatic bile ducts. What is the most likely diagnosis?

- a. primary sclerosing cholangitis
- b. choledocholithiasis
- c. primary biliary cirrhosis
- d. ascending cholangitis
- e. chronic pancreatitis

49) a. \*\*\*\*

Primary sclerosing cholangitis is an idiopathic, progressive, fibrosing, inflammatory disorder of the biliary tree, causing multifocal strictures,

cholestasis and biliary cirrhosis. There is an association with inflammatory bowel disease and autoimmune conditions. In most cases, both intra- and extrahepatic ducts are involved, and classic appearances on cholangiography are of a 'string-of-beads' appearance with alternating segments of dilatation and stenosis. Biliary cirrhosis develops in up to 49% of cases, and there is an increased risk of cholangiocarcinoma. In primary biliary cirrhosis, disease is limited to the intrahepatic bile ducts. In ascending cholangitis, there may be biliary dilatation and pneumobilia, but multifocal strictures are not a feature. CT features of choledocholithiasis include biliary dilatation and visualization of a stone in the bile duct, but again strictures are not a feature. Chronic pancreatitis may result in a smooth inflammatory stricture of the intrapancreatic portion of the common bile duct.

60) In a 67-year-old female patient with jaundice and gallbladder wall thickening on ultrasound scan, which feature on CT favours a diagnosis of xanthogranulomatous cholecystitis rather than gallbladder carcinoma?

- a. pericholecystic fat infiltration
- b. intramural hypoattenuating nodules throughout the gallbladder
- c. biliary obstruction
- d. hepatic extension
- e. regional lymphadenopathy

60) b. \*\*\*\*

Xanthogranulomatous cholecystitis (XGC) is an uncommon inflammatory disease of the gallbladder, which is characterized by multiple intramural nodules and proliferative fibrosis. It is thought to result from rupture and extravasation of bile and mucus following the occlusion of Rokitsansky–Aschoff sinuses. There is considerable overlap between the clinical and radiological features of XGC and gallbladder carcinoma. Pericholecystic infiltration, biliary obstruction, regional lymphadenopathy and hepatic involvement may be seen in both conditions, and the difference in incidence between the two conditions

is not statistically significant. Only the presence of multiple intramural hypoattenuating nodules (representing xanthogranulomas) occupying a large area of the thickened gallbladder wall allows a diagnosis of XGC to be made with any degree of certainty. Similar hypoattenuating intramural nodules (representing haemorrhage and necrosis) may be seen less commonly in gallbladder carcinoma, but these tend to occupy a much smaller proportion of the thickened gallbladder wall.



- 70) A 68-year-old woman presents with abdominal pain, distension and vomiting. Plain abdominal radiograph demonstrates bowel obstruction, gas within the biliary tree, and an ectopic, calcified, 3 cm gallstone. What is the most likely site of bowel obstruction?
- a. pylorus
  - b. duodenum
  - c. proximal ileum
  - d. terminal ileum
  - e. sigmoid

70) d. \*\*\*

Gallstone ileus accounts for up to 5% of intestinal obstruction, increasing in prevalence with age. It involves erosion of a large gallstone from the gallbladder or common bile duct into the bowel, which goes on to cause obstruction. The classic appearance on plain film (Rigler's triad) is only seen in 10% of cases, and consists of partial or complete intestinal obstruction (usually small bowel), gas in the biliary tree and an ectopic calcified gallstone. The most common site of fistulous communication is between the gallbladder and the duodenum, seen in 60%, and this may be demonstrated on barium meal as a contrast collection lateral to the first part of the duodenum representing barium within the gallbladder. Fistulas occur less commonly between the common bile duct and duodenum, gallbladder and colon. The ectopic gallstone most often causes obstruction at the terminal ileum (60–70%), followed by the proximal ileum, distal ileum, pylorus, sigmoid and duodenum.

98) A 22-year-old woman with known medullary sponge kidney presents with recurrent upper abdominal pain and jaundice. Cholangiography demonstrates segmental saccular dilatation of the intrahepatic bile ducts and ectasia of the extrahepatic ducts. What is the most likely diagnosis?

- a. choledochoceles
- b. choledochal cyst
- c. primary sclerosing cholangitis
- d. Caroli's disease
- e. polycystic liver disease

98) d. \*\*\*\*

Caroli's disease is a rare congenital disorder characterized by multifocal segmental saccular dilatation of the intrahepatic bile ducts. It presents in childhood and early adulthood with upper abdominal pain, fever and transient jaundice. Up to 80% of patients have associated medullary sponge kidney. Typical CT findings are of multiple cystic structures with a central enhancing 'dot', representing the portal vein radicles surrounded by dilated ducts. Cholangiography is diagnostic and demonstrates saccular dilatation of the intrahepatic ducts of up to 5 cm in diameter, with frequent associated ectasia of the extrahepatic ducts. Choledochal cysts primarily cause cystic dilatation of the common bile duct, but there may be associated intrahepatic biliary dilatation. A choledochocoele is a cystic dilatation of the intraduodenal portion of the common bile duct. Primary sclerosing cholangitis classically causes multifocal strictures of the intrahepatic and extrahepatic ducts, alternating with segments of dilatation. In polycystic liver disease, there is no communication of the cysts with the biliary tree.

22. A 41 year old woman has an outpatient ultrasound scan for intermittent right upper quadrant pain. Five 5 mm gallstones and sludge are present. In addition, there is wall thickening of the gallbladder fundus with multiple foci of increased echogenicity within the wall, each associated with bright artefacts deep to them. Which one of the following is the most likely diagnosis?
- a. Porcelain gallbladder
  - b. Emphysematous cholecystitis
  - c. Acute cholecystitis
  - d. Adenomyomatosis of the gallbladder
  - e. Gallbladder carcinoma

**22. d. Adenomyomatosis of the gallbladder**

The correct diagnosis is adenomyomatosis. This is an uncommon condition, more common in females, and is associated with gallstones in the majority of cases. It is characterised by generalised or focal mural thickening with intramural diverticula (Rokitansky-Aschoff sinuses). The ultrasound artefact from cholesterol crystals in the sinuses produces bright 'comet-tail' reverberation artefacts.

23. A 32 year old man has an ultrasound scan for obstructive jaundice. Areas of intrahepatic duct dilatation are seen, with increased echogenicity of the portal triads. ERCP reveals alternating segments of dilatation and stenosis of both the intra- and extrahepatic ducts. Which one of the following diagnoses is most likely?
- a. Primary sclerosing cholangitis
  - b. Primary biliary sclerosis
  - c. Ascending cholangitis
  - d. Choledochal cyst
  - e. Congenital hepatic fibrosis

**23. a. Primary sclerosing cholangitis**

These ultrasound and ERCP features are typical of primary sclerosing cholangitis, which is an idiopathic condition characterised by progressive fibrosis of the biliary tree. It primarily affects young men with inflammatory bowel disease (more common in ulcerative colitis than Crohn's) although pancreatitis, liver cirrhosis and chronic active hepatitis are other associated conditions. Primary biliary cirrhosis may also cause scattered areas of focal intrahepatic duct dilatation, but this condition is much more common in females and the extrahepatic ducts are not involved.



24. A neonate is investigated for obstructive jaundice and as part of the investigation has a hepatobiliary iminodiacetic acid (HIDA) nuclear medicine scan. This shows a photopaenic area within the liver and lack of visualisation of the small bowel. Which one of the following conditions would be most consistent with these findings?
- a. Enteric duplication cyst
  - b. Biliary duct atresia *No photopaenic area + small bowel not visible*
  - c. Choledochal cyst
  - d. Pancreatic pseudocyst
  - e. Hepatic cyst *→ photopaenic area but small bowel is visible*

24. c. Choledochal cyst

The only one of the listed diagnoses that would have both these features on HIDA scan is a choledochal cyst. This is a congenital condition characterised by dilatation of the common bile duct and common hepatic duct. Patients typically present in childhood with right upper quadrant pain, a mass and/or obstructive jaundice. Although the diagnosis is usually made with MRCP, HIDA scan can show typical features that include a photopaenic area in the liver representing the dilated CBD/CHD. Although a hepatic cyst would also show a photopaenic area within the liver, small bowel visualisation would be expected. Congenital biliary atresia would cause lack of small bowel visualisation, but the whole liver would take up HIDA and photopaenia would not be present.

25. A one year old boy is admitted unwell with generalised abdominal tenderness and guarding. A supine plain abdominal film is requested, which shows a large oval radiolucency in the middle of the abdomen, with a well-defined linear opacity in the right upper quadrant. Which one of the following conditions would best explain these appearances?
- a. Enteric duplication cyst
  - b. Choledochal cyst
  - c. Pneumoperitoneum *5521*
  - d. Duodenal atresia
  - e. Caecal volvulus

29. A 71 year old female is admitted via A&E with abdominal pain, abdominal distension and vomiting. Plain abdominal film shows multiple dilated loops of small bowel. In addition there is gas projected over the liver shadow which is prominent centrally and has a branching appearance. Gas is not visible over the periphery of the liver. No other abnormality is seen on the plain film. Which of the following diagnoses is most likely?
- a. Small bowel perforation
  - b. Small bowel infarction
  - c. Gallstone ileus
  - d. Emphysematous cholecystitis
  - e. Pneumatosis intestinalis

29. c. Gallstone ileus

Specific signs of gallstone ileus can be seen on the plain abdominal film in up to 40% of patients. Fifty per cent of patients have evidence of small bowel obstruction and up to 30% have gas in the biliary tree. Biliary tree gas is typically more prominent centrally and spares the periphery of the liver, whereas portal venous gas is more easily visualised in the periphery of the liver, which may be associated with small bowel infarction. The gallstone most frequently lodges in the terminal ileum, but is often not seen on the plain film. The presence of small bowel obstruction, pneumobilia and a visible stone are called Rigler's triad.

45. A 39 year old woman has an ultrasound scan for right upper quadrant pain and jaundice which reveals biliary ductal dilatation to the level of the common hepatic duct adjacent to a stone in the gallbladder neck. The gallbladder is thick-walled and tender. MRCP confirms these findings and excludes common duct stones. Which one of the following is the most likely diagnosis?
- a. Primary sclerosing cholangitis
  - b. Mirizzi syndrome
  - c. Caroli's disease
  - d. Fascioliasis
  - e. Acute cholecystitis



**45. b. Mirizzi syndrome**

Mirizzi syndrome is narrowing of the common hepatic duct caused by a gallstone impacted in the neck of the gallbladder or the cystic duct. The stricture is smooth and often concave to the right as seen on ERCP. Fistulae can develop between the gallbladder and the common duct, and the stone may pass into the common duct. It is associated with acute cholecystitis. Fascioliasis is caused by liver fluke infestation which may cause bile duct wall thickening and multiple hepatic abscesses. Caroli's disease is a congenital disorder characterised by cystic dilatation of the intrahepatic bile ducts.

60. A 60 year old male has an abdominal ultrasound for the investigation of deranged LFTs. A 2 cm hyperechoic mass is seen at the porta hepatis. There is dilatation of the right and left hepatic ducts but the common bile duct is of normal calibre. A PET-CT is performed which shows an FDG-avid lesion corresponding to the abnormality on ultrasound and no other findings. Which of the following is the most likely diagnosis?

- a. Caroli's disease
- b. Klatskin tumour
- c. Periampullary tumour
- d. Primary sclerosing cholangitis
- e. Biliary cystadenoma

**60. b. Klatskin tumour**

Klatskin tumours are the most common form of cholangiocarcinoma, representing tumour at the confluence of the hepatic ducts. The finding of a hyperechoic central porta hepatis mass at ultrasound is typical. Risk factors include inflammatory bowel disease, primary sclerosing cholangitis, Caroli's disease and cholecystolithiasis. Cholangiocarcinomas have a very poor prognosis with a five-year survival of less than 2%. They are FDG-avid and PET-CT is typically performed in the pre-operative evaluation of these tumours.

- 52 A fit 67-year-old female underwent an ultrasound to investigate right upper quadrant pain which demonstrated an abnormal gallbladder. Further imaging with CT confirmed a diagnosis of a porcelain gallbladder. What is the probability of a carcinoma developing in such patients?
- a 1%
  - b 15%
  - c 50%
  - d 85%
  - e 99%

52 Answer B: 15%

Porcelain gallbladder is rare but is associated with chronic cholecystitis. The incidence of carcinoma has been reported at 10–30%, therefore cholecystectomy is often advised.

- 53 A 40-year-old woman was admitted to the Neuro-ITU after a subarachnoid bleed and on day nine developed systemic inflammatory response syndrome (SIRS). She had, by this stage, been successfully weaned off the ventilator and her chest radiograph and urine cultures were normal. Blood cultures grew *Salmonella*. A limited portable transabdominal ultrasound showed free fluid in the upper abdomen. What is the most likely diagnosis?
- a Acute pancreatitis
  - b Perforated peptic ulcer disease
  - c Portal vein thrombosis
  - d Acute cholecystitis
  - e Ruptured abdominal aortic aneurysm

53 Answer D: Acute cholecystitis

- 54 A 40-year-old woman underwent transabdominal ultrasound for investigation of right upper quadrant pain two days after an uncomplicated laparoscopic cholecystectomy. This showed a moderate volume of subhepatic free fluid, but a normal common bile duct (CBD). A diagnostic aspirate of this fluid showed it contained bile. What complication is she most likely to have suffered?
- a Clipping of the CBD
  - b Transection of the CBD
  - c Liver haemorrhage
  - d Injury to the duct of Luschka
  - e Subhepatic abscess

54 Answer D: Injury to the duct of Luschka

An accessory biliary duct can be injured despite good visualisation of the CBD.

- 55 A patient presented unwell with abdominal pain and bilious vomiting. They had previously suffered from episodes of acute cholecystitis secondary to gallstones. On this occasion initial investigations showed abnormal liver function tests and a plain abdominal radiograph demonstrated an ileus. The surgical team requested a CT as they were concerned of the possibility of a biliary-enteric fistula. A contrast-enhanced abdominal CT was performed and pneumobilia was noted. What other feature would most support the diagnosis of a biliary-enteric fistula?
- a Distended gallbladder with a thickened wall up to 5 mm
  - b Gallbladder totally collapsed around multiple small gallstones
  - c Shrunken gallbladder mimicking a diverticulum of the duodenal bulb
  - d Shrunken gallbladder with a thickened wall up to 5 mm
  - e Thick-walled gallbladder directly adjacent to the duodenal bulb

55 Answer C: Shrunken gallbladder mimicking a pseudodiverticulum of duodenal bulb.

Ninety per cent of cholecystoduodenal fistulae are associated with perforation due to gallstones. Radiological appearances include pneumobilia and the presence of a shrunken gallbladder mimicking a diverticulum of the duodenal bulb.

- 56 A 23-year-old female with a history of vague upper abdominal pain was investigated with an ultrasound which demonstrated multiple cystic structures converging towards the porta hepatis and communicating with the bile ducts. Cholangiography showed ectatic intrahepatic ducts extending to the periphery and the common bile duct was also dilated. What is the most likely diagnosis?
- a Biliary hamartoma
  - b Caroli's disease
  - c Primary biliary cirrhosis
  - d Primary sclerosing cholangitis
  - e Pyogenic cholangitis

56 Answer B: Caroli's disease

Caroli's disease is a rare congenital condition with multifocal segmental cystic dilatation of the large intrahepatic bile ducts, which communicates with the biliary tree.

- 57 A previously well elderly male patient was admitted with painless obstructive jaundice. Upper abdominal ultrasound showed intrahepatic duct dilatation but normal-calibre extrahepatic ducts. Percutaneous transhepatic cholangiography with separate left and right duct system punctures demonstrated dilated but otherwise normal intrahepatic ducts. The central ducts were not opacified. What is the most likely diagnosis?
- a Inflammatory biliary stricture
  - b Klatskin tumour
  - c Pancreatic head tumour
  - d Primary biliary cirrhosis
  - e Primary sclerosing cholangitis

57 Answer B: Klatskin tumour

Hilar cholangiocarcinoma (Klatskin tumour) is a common cause of biliary obstruction in older patients. Lack of communication between the left and right-sided intrahepatic ducts and normal-calibre extrahepatic ducts are typical findings. Apart from the ductal abnormalities CT findings may be subtle. The tumour mass is often isodense and may show delayed enhancement.

- 58** A 40-year-old woman with a one-year history of symmetrical metacarpophalangeal joint arthritis and a dry mouth was admitted with abdominal distension. She underwent a contrast-enhanced CT of her liver which showed ascites, marked caudate hypertrophy and scattered dilated intrahepatic ducts. Her common bile duct measured 5 mm. What is the most likely diagnosis?
- a Primary sclerosing cholangitis
  - b Obstructive cholangiolithiasis
  - c Primary biliary cirrhosis
  - d Alcoholic hepatitis
  - e Haemochromatosis

**58** Answer C: Primary biliary cirrhosis

This is a chronic non-suppurative cholangitis and is associated with autoimmune disorders including rheumatoid arthritis, scleroderma, and Hashimoto's thyroiditis. Sixty-six to one hundred per cent have Sjögren's syndrome symptoms. CT signs include dilated intrahepatic ducts that do not appear to communicate with the main ducts and a hyperattenuating hypertrophied caudate lobe (in 98%) surrounded by hypoattenuating rind-like right lobe (pseudotumour) with a shrunken lateral left lobe.

- 61** A two-week-old male neonate was noted to be becoming progressively more jaundiced. Transabdominal ultrasound showed mild hepatomegaly with an echogenic 'triangle' of tissue at the porta hepatis. The gallbladder appeared normal but there was polysplenia. What is the most likely diagnosis?
- a Neonatal hepatitis
  - b Sclerosing cholangitis
  - c Haemolysis
  - d Congenital biliary atresia
  - e Alagille Syndrome

**61** Answer D: Congenital biliary atresia

It is best diagnosed with cholescintigraphy which shows good hepatic uptake but no biliary excretion. Triangular fibrous cord at porta hepatis seen on ultrasound is pathognomonic.



- 50 An overweight elderly female patient with a strong smoking history had an ultrasound of her abdomen and pelvis. Her gallbladder contained some small stones and the wall measured 2-mm thick except for an irregular focal area that was 6-mm thick. There was no acoustic shadowing from this thickened area. The gallbladder was of normal volume and the bile ducts were not dilated. What is the most likely diagnosis?
- a Carcinoma of the gallbladder
  - b Hyperplastic cholecystoses
  - c Inflammatory polyp
  - d Metastases from malignant melanoma
  - e Wall-adherent gallstone

50 Answer A: Carcinoma of the gallbladder

An irregular focal area of wall thickening is suggestive of gallbladder carcinoma. Risk factors include increased body mass, female gender, post-menopausal status and cigarette smoking. In up to 90% of gallbladder carcinomas cholelithiasis is present.

- 51 A middle-aged male underwent an ultrasound of his abdomen which showed sludge within a thin-walled gallbladder and no calculi. How likely is it that this patient will go on to develop gallstones?
- a 0%
  - b 5–15%
  - c 30–45%
  - d 60–70%
  - e 95%

51 Answer B: 5–15%

Sludge on ultrasound is seen as dependent echoes that do not cause shadowing. Common causes are chronic fasting, total parental nutrition, critical illness, ceftriaxone therapy and pregnancy. Spontaneous resolution occurs in 50% of patients and 5–15% will go on to develop gallstones.

- 52 An elderly gentleman was admitted with severe abdominal pain, jaundice and sepsis. He had a significant cardiac history, suffered from chronic airways disease and was a high anaesthetic risk. An ultrasound and CT confirmed severe calculus cholecystitis with a distended gallbladder but no common bile duct dilation. The patient was not responding well to intravenous antibiotic therapy and continued to deteriorate. What would be the most appropriate next step?
- a ERCP
  - b Laparoscopic cholecystectomy
  - c MRCP
  - d Open cholecystectomy
  - e Percutaneous cholecystostomy

52 Answer E: Percutaneous cholecystostomy

Percutaneous cholecystostomy can often be performed in poor surgical candidates or acutely unwell patients.

- 53 A 75-year-old female had an abdominal radiograph as part of a work-up for chronic right upper quadrant pain. This showed a porcelain gallbladder. She subsequently has a transabdominal ultrasound which showed a fundal mass in the gallbladder, but no gallstones and gallbladder carcinoma was suspected. What is the most common mode of spread?
- a Infiltration of liver
  - b Neural spread
  - c Lymphatic spread to cystic nodes
  - d Lymphatic spread to coeliac nodes
  - e Haematogenous

53 Answer A: Infiltration of liver

Carcinoma of the gallbladder most commonly spreads by direct extension into the liver. Lymphatic spread and peritoneal seeding are also common. Neural spread tends to be associated with more aggressive tumours. Haematogenous spread is relatively rare.

- 54 A 20-year-old woman presented with ongoing chronic vague abdominal pain. She was otherwise well and was taking the oral contraceptive pill. On examination there was a palpable mass in the right upper quadrant and her sclera appeared yellow. An urgent outpatient ultrasound was organised and a choledochocoele was suspected. What ultrasound finding would support this diagnosis?
- a Cystic change of the intrahepatic ducts
  - b Dilatation of the distal intramural portion of the common bile duct that protrudes in the duodenum
  - c Diverticular outpouching of the extrahepatic duct
  - d Fusiform dilatation of the extrahepatic duct
  - e Multifocal saccular dilatation of the intrahepatic ducts with sparing of the extrahepatic ducts

- 54 Answer B: Dilatation of the distal intramural portion of the common bile duct that protrudes in the duodenum

A choledochocoele is cystic dilatation of the distal/intramural duodenal portion of the common bile duct with herniation of the duct into the duodenum.

- 55 A patient presented with right upper quadrant pain, fever and jaundice. An ultrasound demonstrated a thick-walled gallbladder containing numerous gallstones and a stone impacted in the common bile duct. Which organism is most likely to be grown from their blood cultures?
- a *Pseudomonas*
  - b *Klebsiella*
  - c *Escherichia coli*
  - d *Haemophilus influenzae*
  - e *Clostridium difficile*

- 55 Answer C: *Escherichia coli*

Gram-negative enteric bacteria are the usual causative agent in ascending cholangitis, the commonest being *E. coli*.

- 56** Following a long history of intermittent right upper quadrant pain a middle-aged woman became jaundiced. She was referred for an ultrasound which showed a cystic lesion adjacent to the gallbladder. A CT confirmed the presence of a thin-walled lesion with a fluid attenuation centre. The intrahepatic ducts were normal in calibre. In view of her jaundice she then had an ERCP and a cholangiogram showed a tubular structure which communicated with the gallbladder and cystic duct. What is the most likely diagnosis?
- a Biloma
  - b Caroli's disease
  - c Choledochal cyst
  - d Enteric duplication cyst
  - e Pancreatic pseudocyst

**56** Answer C: Choledochal cyst

Choledochal cysts are formed by cystic dilatation of the intra- or extrahepatic biliary ducts. The diagnosis is established at cholangiography. Caroli's disease affects only the intrahepatic ducts.

- 57** A 23-year-old male presented with his third episode of right upper quadrant pain, fever and jaundice in six months. A contrast-enhanced CT showed multiple intrahepatic cysts, some of which showed strongly enhancing tiny central dots and focal calcification. There were also cystic foci in the renal parenchyma bilaterally. What is the most likely diagnosis?
- a Polycystic liver disease
  - b Biliary haemangioma
  - c Primary sclerosing cholangitis
  - d Caroli's disease
  - e Ascending cholangitis

**57** Answer D: Caroli's disease

The best diagnostic clue is the 'central dot' sign – strongly enhancing central tiny dots and the presence of renal tubular ectasia. Patients often present in their second to third decade with recurrent cholangitis. ERCP, MRCP and technetium colloid sulphur are most helpful.

- 58 A 55-year-old man presented with painless jaundice and was diagnosed with extrahepatic cholangiocarcinoma. What is the most common mode of spread?
- a Infiltration of liver
  - b Peritoneal seeding
  - c Lymphatic spread to cystic lymph nodes
  - d Lymphatic spread to coeliac lymph nodes
  - e Haematogenous

58 Answer C: Lymphatic spread to cystic lymph nodes

Lymphatic spread to cystic nodes 32%, infiltration of liver 23%, lymphatic spread to coeliac nodes 16%, peritoneal seeding 9%, haematogenous spread is rare.

- 59 A 40-year-old woman presented with right upper quadrant pain. A transabdominal ultrasound showed multiple gallstones in a thick-walled gallbladder with a trace of pericholecystic free fluid. She subsequently developed a biliary enteric fistula. What is the most likely site of communication with the gastrointestinal tract?
- a Duodenum
  - b Colon
  - c Stomach
  - d Jejunum
  - e Ileum

59 Answer B: Duodenum

- 60 A previously well 40-year-old woman was admitted with a one-week history of right upper quadrant pain and vomiting. An abdominal radiograph taken on admission showed dilated small bowel loops containing a number of lamellated calcific densities and pneumobilia. What is the most likely diagnosis?
- a Acute cholecystitis
  - b Acute pancreatitis
  - c Cholangitis
  - d Gallstone ileus
  - e Gastric volvulus

60 Answer D: Gallstone ileus



- 61** A 30-year-old female smoker was investigated for general malaise and epigastric discomfort with a transabdominal ultrasound. This showed gallstones in a thin-walled gallbladder and echogenic soft tissue around the distal common bile duct and pancreatic head but no dilatation of any of the duct system. What is the most likely diagnosis?
- a** Pancreatic head carcinoma
  - b** Chronic pancreatitis
  - c** Impacted distal CBD stone
  - d** Lymphoma
  - e** Pancreatic metastasis

**61** Answer D: Lymphoma

This is a 'soft' tumour, which does not usually obstruct ducts.

- 38** A patient with shortness of breath underwent abdominal ultrasound which showed a thick-walled gallbladder but no gallstones. They were pain free and routine serum biochemical markers including C-reactive protein, albumin, eGFR and liver transaminases were normal. What is the most likely explanation for the gallbladder wall thickening?
- a** Cirrhosis
  - b** Viral hepatitis
  - c** Cardiac failure
  - d** Renal failure
  - e** Cholecystitis

**38** Answer C: Cardiac failure

- 49 A diabetic 70-year-old man was admitted with right upper quadrant pain. He became rapidly more unwell with evidence of sepsis and an urgent ultrasound of his abdomen was arranged. A previous ultrasound six months ago demonstrated stones within the gallbladder but little else. What feature on the more recent scan would suggest a diagnosis of the more unusual emphysematous cholecystitis over simple acute cholecystitis?
- a Arc-like hyperechogenic areas outlining the gallbladder wall
  - b Gallbladder wall thickening over 5 mm
  - c Hazy delineation of the gallbladder
  - d Intramural gas
  - e The 'halo sign'

49 Answer A: Arc-like hyperechogenic areas outlining the gallbladder wall  
Intramural gas can occur with any severe cholecystitis that causes gross inflammation and compromises the gallbladder wall. Arc-like echoes that outline the gallbladder wall represents gas within the gallbladder itself, which occurs in emphysematous cholecystitis and not simple acute cholecystitis. Emphysematous cholecystitis is associated with calculous and is more prevalent in diabetics. Complications include gallbladder gangrene and perforation. The halo sign is a three-layered configuration of the gallbladder wall with a lucent middle layer, which represents oedema and is a common observation in acute cholecystitis.

- 50 A US abdomen of a 37-year-old lady with a one-month history of intermittent right upper quadrant pain showed an abnormality within the gallbladder. There was no further abnormality elsewhere. What feature on ultrasound would be more in keeping with sludge rather than a polyp?
- a Hyper-reflective
  - b Non-shadowing and mobile
  - c Non-shadowing and non-mobile
  - d Shadowing and mobile
  - e Shadowing and non-mobile

50 Answer B: Non-shadowing and mobile

	Common cause	Less common
Shadowing, mobile	Stones	Nil
Non-shadowing, mobile	Sludge	Small stones (<3 mm)
Non-shadowing, non-mobile	Polyps	Sludge

51 A patient underwent an abdominal ultrasound on which it was difficult to identify her gallbladder but there was a large amount of pericholecystic fluid. The patient then had a contrast-enhanced CT which demonstrated pockets of air in the gallbladder wall and abnormal mucosal enhancement of the gallbladder wall with a small defect laterally. What is the most likely diagnosis?

- a Acute acalculous cholecystitis
- b Acute calculus cholecystitis
- c Emphysematous cholecystitis
- d Gangrenous cholecystitis
- e Gallbladder perforation

51 Answer E: Gallbladder perforation

Gallbladder perforation occurs in 5–10% of patients with acute cholecystitis. Localised disruption of the gallbladder wall is seen on ultrasound in less than 40% of cases and CT in 80%.

52 A 50-year-old man with type 2 diabetes was diagnosed with acute cholecystitis. Transabdominal ultrasound showed gas artefact echoes outlining the gallbladder wall. What is the most likely causative organism?

- a *Clostridium difficile*
- b *Clostridium perfringens*
- c *Escherichia coli*
- d *Staphylococcus aureus*
- e *Staphylococcus epidermidis*

52 Answer B: *Clostridium perfringens*

*Clostridium perfringens* is the most common cause of emphysematous cholecystitis. There is an approximately 15% mortality.

- 53 A 40-year-old woman was admitted with colicky right upper quadrant pain. An ultrasound showed a thick-walled gallbladder but no gallstones. Subsequently, scintigraphy was performed to assess the patency of her cystic duct. What is the most specific sign of an impacted cystic duct stone?
- a Non-visualisation of the gallbladder by one hour
  - b Non-visualisation of the gallbladder by four hours
  - c Non-visualisation of the GB and CBD
  - d Pericholecystic rim sign
  - e Increased perfusion to gallbladder fossa during arterial phase

53 Answer B: Non-visualisation of the gallbladder by four hours  
(Ninety-nine per cent specific.)

- 54 A 55-year-old male had been complaining of general malaise and weight loss for approximately six months. He had a past medical history of a total colectomy in early adulthood following a diagnosis of a familial adenomatous polyposis syndrome. CT and MRCP demonstrated double duct dilation. No other pathology was identified and an endoscopy was also unremarkable. What is the most likely diagnosis?
- a Ampullary stricture
  - b Ampullary tumour
  - c Choledochocoele
  - d Gallstone impaction at the ampulla
  - e Peri-ampullary tumour

54 Answer B: Ampullary tumour

Ampullary tumours have an association with FAP syndrome. The tumour is often inconspicuous due to its small size. Peri-ampullary tumours are usually larger lesions with significant intraduodenal extension.

- 55 A 45-year-old man presented with progressive jaundice and abnormal liver function tests. An ultrasound of his liver showed bright portal tracts and a filling defect in the common bile duct. An ERCP demonstrated multifocal strictures particularly at the bifurcations of the biliary ducts and a 'string of beads' appearance. Small saccular outpouchings were also visible. What is the most likely diagnosis?
- a Primary sclerosing cholangitis
  - b Cholangiocarcinoma
  - c Bacterial cholangitis
  - d Primary biliary cirrhosis
  - e Gallbladder perforation

55 Answer A: Primary sclerosing cholangitis (PSC)

PSC is more common in males by approx 2:1. Usually presents by 45 years.

- 56 A patient with known cholelithiasis developed jaundice and underwent ultrasound and subsequent MRCP which confirmed a diagnosis of Mirizzi's syndrome. What radiological features would be expected?
- a Course of cystic duct perpendicular to common hepatic duct
  - b Dilatation of common bile duct to the ampulla
  - c Impacted gallstone in the pouch of Douglas
  - d Air in the intrahepatic ducts
  - e Fistulation between the gallbladder and common hepatic duct

56 Answer E: Fistulation between the gallbladder and common hepatic duct

In Mirizzi's syndrome a gallstone impacts in the gallbladder neck or cystic duct and causes extrinsic compression of the common hepatic duct. It is frequently associated with the formation of a fistula between the gallbladder and common hepatic duct.



- 57 A 36-year-old woman who was known to be HIV positive presented with right upper quadrant pain, jaundice and a fever. An admission USS liver showed dilated thick-walled bile ducts. She was diagnosed with an opportunistic infection. What is the most likely causative organism?
- a *Pneumocystis (PCP)*
  - b *Cryptococcus*
  - c HIV
  - d *Cytomegalovirus*
  - e *Escherichia coli*

57 Answer D: *Cytomegalovirus*

CMV and *cryptococcus* are the most common opportunistic infective organisms. HIV can also cause cholangitis but is not an opportunistic infection.

- 58 A 55-year-old man presented with a three-month history of right upper quadrant pain and two-stone weight loss. On examination there was a tender palpable mass. His serum bilirubin was 15 micromol/L and his alkaline phosphatase 200 IU/L. An ultrasound showed a hyperechoic 5-cm mass in the lateral right lobe of the liver and dilated bile ducts peripheral to this area. A CT showed this mass to be hypodense and early rim enhancement followed by marked homogeneous delayed enhancement was visible. What is the most likely diagnosis?
- a Metastatic adenocarcinoma
  - b Metastatic leiomyosarcoma
  - c Intrahepatic cholangiocarcinoma
  - d Hepatocellular carcinoma
  - e Carcinoid

58 Answer C: Intrahepatic cholangiocarcinoma

There is a predilection for the right lobe and this accounts for around 10% of all cholangiocarcinomas. Up to 20% are resectable. The peripheral washout sign and delayed enhancement on CT are suggestive.

- 59 An 18-year-old woman was investigated for right upper quadrant pain and two episodes of jaundice. An ultrasound showed a large cyst below the porta hepatis, which was separate from gallbladder and communicated with the common hepatic duct. A HIDA scan showed only equivocal uptake. What is the most likely diagnosis?
- a Hepatic cyst
  - b Intrahepatic gallbladder
  - c Pancreatic pseudocyst
  - d Biloma
  - e Choledochal cyst

59 Answer E: Choledochal cyst

Communication to common hepatic/intrahepatic duct is vital for diagnosis. HIDA uptake is variable, but a positive result shows a photopenic area that fills in within 60 minutes, with a paucity of contrast in the small bowel.

- 60 A 55-year-old man had been diagnosed with ulcerative colitis aged 40 and had a total colectomy at 42 years old. He had been asymptomatic until presenting with a one-month history of right upper quadrant pain and jaundice. Transabdominal ultrasound showed prominent right intrahepatic ducts with echogenic walls. What is the most likely diagnosis?
- a Portal vein thrombosis
  - b Primary biliary cirrhosis
  - c Intrahepatic cholangiocarcinoma
  - d Ascending cholangitis
  - e Viral hepatitis

60 Answer C: Intrahepatic cholangiocarcinoma

Increased risk in inflammatory bowel disease (by 10×) particularly ulcerative colitis and primary sclerosing cholangitis (PSC) with a latent period of approximately 15 years. Right lobar predilection. Poor prognosis.

- 61 A one-month-old baby girl with a persistent productive cough developed progressively worsening respiratory distress. She had a chest radiograph which showed clear lungs. Linear gas shadows were visible projected over the central liver. What is the most likely diagnosis?
- a Respiratory distress syndrome
  - b Bronchopneumonia
  - c Tracheoesophageal fistula
  - d Congenital tracheobiliary fistula
  - e Pulmonary emboli

61 Answer D: Congenital tracheobiliary fistula

The finding of pneumobilia is key to thinking of the diagnosis.

10. A 65-year-old man presents with weight loss and obstructive jaundice. An ultrasound reveals dilatation of the intra- and extrahepatic biliary system. MRCP reveals a stricture in the distal common bile duct (CBD). The patient becomes septic and biliary drainage is required. Which is the most appropriate method for this?

- A. Percutaneous transhepatic cholangiography (PTC) and external drainage.
- B. PTC with internal/external drainage.
- C. ERCP with plastic stent insertion.
- D. ERCP with metal stent insertion.
- E. PTC/ERCP rendezvous procedure.

10. C. ERCP with plastic stent insertion.

PTC is an appropriate approach, but biliary sepsis can cause bacteraemia during PTC and thus ERCP is preferable in this case, if possible. Contraindications to PTC include prothrombin time greater than 2 seconds higher than control, platelet count less than 100,000, ascites, hydatid disease, and lack of access to surgical facilities. If an ERCP were to fail, the other options would be viable alternatives. Metal stent insertion at the first instance is inappropriate unless it is known that the biliary dilatation is due to inoperable malignancy. This is because metal stents cannot be removed, whereas the plastic variety can be removed, if necessary.

**17. A 72-year-old male patient presents to the surgical team with a 3-week history of increasing painless jaundice. He has a past medical history of gallstones, prostatic carcinoma, and ischaemic heart disease. There is no history of alcohol abuse. The LFTs are abnormal. Serum bilirubin is 346. He is referred for an ultrasound scan of the abdomen, which identifies grossly dilated intrahepatic bile ducts, but no evidence of a dilated CBD. The common hepatic duct (CHD) is not clearly visible due to an isoechoic mass in the region of the porta hepatis at the ductal confluence. A triple phase CT scan of the liver is carried out. The lesion is iso- to hypo-attenuating. There is limited arterial enhancement, with some portal venous enhancement peripherally. On delayed images the lesion displays enhancement with mild peripheral washout. What is the most likely pathology?**

- ✓ A. Cholangiocarcinoma. *Klatskin*
- B. Portal metastasis.
- C. Hepatocellular carcinoma.
- D. Benign biliary stricture.
- E. Cavernous haemangioma.

**17.A. Cholangiocarcinoma.**

Specifically a Klatskin tumour, as it occurs at the porta hepatis. Cholangiocarcinoma can be iso- to hyperechoic on ultrasound. On CT and MRI, it shows delayed enhancement in 74%. Many conditions predispose to cholangiocarcinoma and gallstones are identified in 20–50% of patients with cholangiocarcinoma. Hepatocellular carcinoma would be the next most likely diagnosis. It can have a variable ultrasonographic appearance. Hepatocellular carcinoma usually demonstrates arterial phase enhancement (80%). Prostate does not commonly metastasize to the liver and would again demonstrate arterial phase enhancement classically. Whilst haemangiomas are classically hyperechoic on ultrasound, larger lesions can appear heterogeneously hypoechoic (40%).



**18. A patient is admitted with right upper quadrant (RUQ) pain to the surgical team and is referred for ultrasound. On the ultrasound there is a curvilinear echogenic line at the margin of the gallbladder and posterior acoustic shadowing in the gallbladder fossa. There is no evidence of peristalsis and the shadowing does not change on patient positioning. The sonographer states that the patient's pain has settled and they are otherwise well. What is the most likely cause of this appearance?**

- A. Bowel in the gallbladder fossa.
- B. Porcelain gallbladder.
- C. Gallstones.
- D. Emphysematous cholecystitis.
- E. Post-ERCP.

**18. B. Porcelain gallbladder.**

It can sometimes be difficult to see a cause for this appearance, and a number of the given options could result in it. However, peristalsis should be seen in a healthy patient if the abnormality is due to bowel. With gallstones, the appearance should change on positioning. There is no mention of an ERCP in the history, and whilst air in the biliary tree is common after sphincterotomy, it is often only seen in the gallbladder immediately after the procedure. Patients with emphysematous cholecystitis are usually clinically unwell and are unlikely to be asymptomatic. Porcelain gallbladder is associated with gallstones in 90% of cases. It is a relevant finding to make as 10–20% of patients develop carcinoma of the gallbladder.

**26. A 45-year-old male presents with a history of jaundice and RUQ pain. An ultrasound of the abdomen demonstrates an impacted calculus in the gallbladder neck with dilatation of the intrahepatic ducts. An MRCP is requested to exclude Mirizzi syndrome. What additional features on MRCP confirm the diagnosis of Mirizzi syndrome?**

- A. Dilated common hepatic duct.
- B. Dilated common hepatic and common bile ducts.
- C. Dilated common hepatic duct with normal common bile duct.
- D. Double duct sign.
- E. Normal ducts.



**26. C.** Dilated common hepatic duct with normal common bile duct.

**Mirizzi syndrome** is a functional hepatic syndrome caused by extrinsic compression of the CHD by a calculus impacted in the gallbladder neck or cystic duct. Low insertion of the cystic duct into the CHD is a predisposing factor.

Typical features at imaging include extrinsic compression of the CHD, a gallstone in the gallbladder neck or cystic duct, dilatation of the intrahepatic ducts and CHD proximally, and a normal CBD. Rarely, inflammation around an impacted calculus leads to a stricture formation mimicking a periductal infiltrating cholangiocarcinoma.

**27. A 60-year-old diabetic male presents with a history of fever and right upper quadrant pain. Ultrasound of the abdomen demonstrates curvilinear high-amplitude echoes in the gallbladder wall with reverberation artefact and multiple high-amplitude echoes in the gallbladder lumen. What is the diagnosis?**

- A. Acute cholecystitis.
- ☒ B. Emphysematous cholecystitis.
- C. Adenomyomatosis.
- D. Chronic cholecystitis.
- E. Cholesterosis.

**27. B.** Emphysematous cholecystitis.

This is a rare form of acute cholecystitis. The majority of patients are between 50 and 70 years of age. It is more common in men (male to female ratio of 2:1) and in those with diabetes and peripheral vascular disease. Emphysematous cholecystitis is a surgical emergency because there is an increased risk of gallbladder perforation and increased mortality rate. The definitive treatment is cholecystectomy, although in critically ill patients percutaneous cholecystostomy may be used as a temporary measure.

**34. A patient presents to A&E with severe upper abdominal pain 4 days following a barium enema. There is no free air under the diaphragm on the erect CXR. There is mild elevation of the inflammatory markers, but the surgeon is concerned with the degree of peritonism and requests a CT scan of abdomen. On this, the small bowel is dilated to 5 cm, but is not thick walled. The vascular structures enhance normally. There is inflammatory change noted around the duodenum. Linear areas of low attenuation are noted extending from the porta hepatis into the liver parenchyma. These do not extend to the margin of the liver and are in general central in their location. The Hounsfield attenuation value of these areas is approximately -1500 HU. Barium in the rectum obscures the images of the pelvis. What is the most likely pathology?**

- A. Cholecystoduodenal fistula.
- B. Mesenteric infarction.
- C. Acute bowel obstruction.
- D. Perforated duodenal ulcer.
- E. Complication of barium enema.

**34.A.** Cholecystoduodenal fistula.

The other answers are all causes of portal air, whereas the salient description is for air in the biliary tree.

**57. A patient has an ultrasound scan carried out on a radiographer's ultrasound list. The radiographer notices an unusual finding and asks you to check the images. The liver, kidneys, and spleen appear unremarkable. There are gallstones in the gallbladder, but also in the fundus of the gallbladder, and there is a reverberation artefact that gives a comet tail appearance. This finding is pathognomonic of a condition. Which of the following statements is true regarding this condition?**

- A. Adenomyomatosis is caused by abnormal deposits of cholesterol esters in foam cells in the lamina propria. *= cholesterosis*
- B. Cholesterosis is caused by the rupture of Rokitansky-Aschoff sinuses with subsequent intramural leak of bile causing an inflammatory reaction. *= xanthogranulomatous cholecystitis*
- C. Xanthogranulomatous cholecystitis is characterized by an increase in the number and height of glandular elements in the gallbladder. *= adenomyomatosis*
- D. Xanthogranulomatous cholecystitis is associated with gallbladder carcinoma in around 10% of cases.
- ~~E.~~ Adenomyomatosis is associated with cholesterosis in up to a third of patients.



**57. E.** Adenomyomatosis is associated with cholesterosis in up to a third of patients.

Option A describes the cause of cholesterosis. Option B describes the features of xanthogranulomatous cholecystitis (XGC). Option C describes the features of adenomyomatosis. Option D is true, but the ultrasound features described are not those of XGC, so this is not true regarding the condition described in the clinical scenario. Adenomyomatosis and cholesterosis are both classed as types of hyperplastic cholecystitis. Adenomyomatosis has two pathognomonic descriptions. Firstly, the 'pearl necklace' appearance on oral cholecystogram (OCG) (the same appearance can be seen on MRCP). Secondly, comet tail artefact seen on ultrasound, caused by reverberation artefact between cholesterol crystals in Rokitsansky–Ashcoff sinuses.

**64. A patient presents to the surgeons with a known history of gallstones, for which she underwent an ERCP 2 years earlier. She has had recurring pain and mildly elevated liver function tests. She underwent an MRCP/MRI liver prior to consideration for surgery. This showed a number of 8-mm filling defects in the CBD. Which of the following MRI sequences is likely to be the most helpful in trying to determine if these filling defects are due to pneumobilia, as opposed to retained calculi?**

- ☒ A. Axial T2 steady-state GE.
- B. Coronal thick slab MRCP.
- C. Three-dimensional volume coronal MRCP.
- D. Two-dimensional coronal oblique thin (4mm) MRCP.
- E. Axial T1 in phase and out of phase GE.

**64.A.** Axial T2 steady-state GE.

Axial imaging is generally going to be better than coronal imaging when trying to distinguish between pneumobilia and calculi within the CBD. The biliary air causes an air/fluid level of air lying on top of fluid in a non-dependent position in the CBD and this is more easily appreciated on an axial image. Calculi tend to lie dependently within the CBD. As fluid is hyperintense on T2WI and hypointense on T1WI, and both air and calculi are hypointense on both these sequences, then both will stand out as being more conspicuous on T2WI.

**75. A 50-year-old male is admitted under the surgical team having presented with upper abdominal pain and raised inflammatory markers. Suspecting acute cholecystitis, an ultrasound is requested, but due to large body habitus there is poor visualization of his gallbladder. To further evaluate hepatobiliary scintigraphy using  $^{99m}\text{Tc}$ -labelled iminodiacetic acid is arranged. Which of the following findings are consistent with acute cholecystitis?**

- ☒ A. Non-visualization of the gallbladder at 1 and 4 hours.
- B. Non-visualization of the gallbladder at 1 hour but seen at 4 hours. = chronic cholecystitis
- C. Visualization of the gallbladder at 1 hour.
- D. Visualization of the gallbladder at 30 minutes after morphine administration.
- E. Hepatobiliary scintigraphy is not appropriate for investigation of acute cholecystitis.

**75.A.** Non-visualization of the gallbladder at 1 and 4 hours.

Hepatobiliary scintigraphy is most commonly used to evaluate suspected acute cholecystitis. A minimum of 2 hours fasting is required. Following prompt uptake by the liver, the radiotracer is excreted into the biliary system and drains into the small bowel. Activity should be demonstrated within the gallbladder by 1 hour. Morphine can be used during the scan to relax the sphincter of Oddi, thus pushing radiolabelled bile into the gallbladder. Acute cholecystitis is characterized by non-visualization of the gallbladder at both 1 and 4 hours or at 30 minutes following morphine administration. Non-visualization of the gallbladder at 1 hour, but seen at 4 hours, is indicative of chronic cholecystitis. A false-positive diagnosis of acute cholecystitis can occur with previous cholecystectomy, gallbladder agenesis, and tumour obstructing the cystic duct.

**26 A 40 year old man is found to have abnormal liver function whilst undergoing routine blood tests prior to abdominal surgery. Subsequent imaging demonstrates a relatively normal liver parenchyma but there is irregularity of the bile ducts with beading and short segment strictures.**

**What is the most likely diagnosis?**

- (a) Autoimmune liver disease
- (b) Viral hepatitis
- (c) Primary biliary cirrhosis
- (d) Cholangiocarcinoma
- (e) Primary sclerosing cholangitis

**26 (e)**

Primary sclerosing cholangitis is a biliary condition of unknown aetiology that is more common in men (2:1) and often presents under the age of 45 years. It is associated with ulcerative colitis, sicca complex and retroperitoneal fibrosis and patients are at increased risk of developing cholangiocarcinoma.

**29 A 47 year old lady attends for an US of her biliary system. Three comet-tail artefacts are seen arising from the anterior wall, which is slightly thickened. The remainder of the examination was unremarkable.**

**What is the most likely cause?**

- (a) Adenomyomatosis
- (b) Cholesterolosis
- (c) Gallstones
- (d) Chronic cholecystitis
- (e) Porcelain gallbladder

**29 (a)**

Adenomyomatosis is caused by mucosal hyperplasia with herniations of mucosa into the thickened muscular layer (Rokitansky-Aschinnoff sinuses). Cholesterol crystals deposited in these sinuses give rise to the hyperechoic comet-tail artefacts from the anterior wall, clearly visible against the hypoechoic bile.



- 31 A patient is referred for the investigation of right upper quadrant pain. US has equivocal findings and a HIDA examination is requested. At 35 minutes, there is little uptake within the liver, but renal excretion is noted.

**What is the most likely cause for these findings?**

- (a) Poor liver function
- (b) Acute cholecystitis
- (c) Poor renal function
- (d) Sphincter of Oddi dysfunction
- (e) Chronic cholecystitis

**31 (a)**

Liver uptake should be seen within 10 minutes. Thereafter, there is filling of the gallbladder and subsequent excretion to the bowel. Cholecystitis impairs uptake to the GB.

- 46 A patient with a biopsy proven cholangiocarcinoma undergoes imaging which demonstrates that the tumour is confined to the common bile duct.

**How would you classify this?**

- (a) Bismuth I
- (b) Bismuth II
- (c) Bismuth III
- (d) Bismuth IV
- (e) Bismuth V

**46 (a)**

A type II stricture extends in to the 1st order ducts. A type III stricture involves 2nd order ducts in either the right (IIIA) or left (IIIB) side, whilst type IV involve 2nd order ducts bilaterally. There is no type V. This classification is used to plan surgery.

**12 Which of the following is not considered to be a risk factor for the development of cholangiocarcinoma?**

- (a) Tobacco smoking
- (b) Heavy alcohol consumption
- (c) Hepatitis C virus
- (d) Polyvinyl chloride exposure
- (e) Caroli disease

**12 (a)**

Tobacco smoking is not associated with cholangiocarcinoma, but there are a large number of other associations, including viral agents (HIV, HBV, EBV), liver flukes, hepatolithiasis, primary sclerosing cholangitis and biliary anomalies.

**32 A 47 year old lady with right upper quadrant pain undergoes an US. This demonstrates gallbladder calculi and focal thickening of the wall at the fundus of the gallbladder. The patient undergoes an MRCP to further evaluate this which shows multiple foci of high signal within the wall of the GB on the T2-weighted images in addition to the calculi.**

**What is the most likely diagnosis?**

- (a) Acute cholecystitis
- (b) Chronic cholecystitis
- (c) Gallbladder carcinoma
- (d) Adenomyomatosis
- (e) Xanthogranulomatous cholecystitis

**32 (d)**

Adenomyomatosis of the gall bladder is characterised by deep, branching invaginations into the thickened GB wall. Seen in approximately 8% GB specimens, and associated with gallstones (90% cases), it is more common in women and often presents with RUQ pain. There are both diffuse and focal forms. The 'string of beads' sign in the GB wall is the hallmark of the disease on MRI and is said to be highly specific in differentiating it from carcinoma.

**38 A 35 year old man undergoes an abdominal US. The report reads: "The liver has a coarse echotexture and there appear to be multiple areas of saccular dilatation of the intrahepatic bile ducts, but no strictures. The CBD is normal. The spleen measures 16 cm. Note is also made of bilateral renal cysts."**

**What is the most likely diagnosis?**

- (a) Primary sclerosing cholangitis
- (b) Primary biliary cirrhosis
- (c) AIDS cholangiopathy
- (d) Caroli's disease
- (e) Polycystic liver disease

**38 (d)**

These are the typical findings at US or MRI. Complications include biliary stasis, cholangitis and abscesses. The coarse echotexture would be in keeping with hepatic fibrosis (not a feature of polycystic disease), whilst PSC and AIDS cholangiopathy have thickening of the bile ducts with strictures. Caroli's disease is associated with renal cysts and medullary sponge kidney.

- 54 A 56 year old lady with jaundice undergoes an MRCP. This demonstrates a gallstone impacted in the neck of the gallbladder. The gallbladder wall is thickened and there is intrahepatic duct dilatation due to the gall bladder compressing the common bile duct.**

**What is the diagnosis?**

- (a) Caroli's disease
- (b) Klatskin syndrome
- (c) Choledocholithiasis
- (d) Mirizzi syndrome
- (e) Cholangitis

**54 (d)**

This is Mirizzi syndrome. The inflamed gallbladder compresses the CBD to result in obstructive jaundice. Patients often have a low insertion of the cystic duct in the common bile duct.

- 61 A 46 year old woman is diagnosed with HIV cholangiopathy.**

**What is the most likely causative organism?**

- (a) Cryptosporidium
- (b) Clonorchis
- (c) Ascaris
- (d) E. coli
- (e) Fasciola hepatis

**61 (a)**

HIV (or AIDS) cholangiopathy is due to opportunistic infection, most commonly with Cryptosporidium, in patients with established HIV infection. Radiological features include duct wall thickening, strictures and duct dilatation.

**74** An otherwise well 35 year old man undergoes an US of the liver which shows a heterogeneous echotexture. Subsequent CT and MRI images demonstrate that the liver is normal in size and has a smooth contour, but that there are innumerable tiny lesions throughout measuring less than 5 mm in diameter. These are predominantly cystic in nature, although a small solid component is present, and return a high signal on T2-weighted images.

**What is the most likely diagnosis?**

- (a) Polycystic liver disease
- (b) Metastases
- (c) Caroli disease
- (d) Biliary hamartomas
- (e) Primary sclerosing cholangitis

**74 (d)**

These are the typical appearances of biliary hamartomas (von Meyenberg complexes), a benign abnormality of the ductal plate which may be misinterpreted as metastases.



- 6) A 44-year-old man undergoes ultrasound of the abdomen during which the liver is incidentally noted to be of diffusely increased echogenicity, with attenuation of the ultrasound beam and poor visualization of the intrahepatic architecture. Which of the following imaging features is most likely in this condition?
- a. liver echogenicity less than that of renal cortex on ultrasound scan
  - b. relatively hypoattenuated intrahepatic vessels on unenhanced CT
  - c. liver attenuation 10 HU greater than that of the spleen on unenhanced CT
  - d. absolute liver attenuation of  $>40$  HU on contrast-enhanced CT
  - e. loss of liver signal intensity on out-of-phase gradient echo MR images

6) e. \*\*\*

Fatty liver describes a spectrum of conditions characterized by triglyceride accumulation within hepatocytes. It is common, affecting around 15% of the general population, but is more prevalent among those with obesity, hyperlipidaemia and high alcohol consumption. Fatty liver may be diagnosed on ultrasound scan if liver echogenicity exceeds that of renal cortex, with attenuation of the ultrasound beam, loss of definition of the diaphragm and poor visualization of the intrahepatic architecture. CT features include absolute attenuation of less than 40 HU on contrast-enhanced CT and, on unenhanced CT, liver attenuation at least 10 HU less than that of spleen, and relatively hyperattenuating liver vasculature. Chemical shift gradient echo imaging is the most widely used MR technique for assessment of fatty liver, demonstrating signal intensity loss on out-of-phase images compared with in-phase images.

16) A previously well, 28-year-old man recently returned from the Far East becomes acutely unwell with fever and right upper quadrant pain. Ultrasound scan demonstrates a well-defined, rounded, 7 cm hypoechoic lesion in the right lobe of the liver contiguous with the liver capsule, with fine homogeneous, low-level internal echoes and acoustic enhancement. What is the most likely diagnosis?

- a. pyogenic abscess
- b. amoebic abscess
- c. fungal abscess
- d. hydatid disease
- e. incidental simple hepatic cyst

16) b. \*\*\*

Pyogenic abscesses are the commonest type of liver abscess in developed countries, and are most frequently due to ascending cholangitis from benign or malignant obstructive biliary disease. They are often poorly defined with irregular walls on ultrasound scan, and may contain debris or demonstrate intense hyperechogenicity when containing gas. Amoebic abscesses tend to occur in younger, more acutely unwell patients from high prevalence areas or with a history of recent travel. They are treated medically whereas pyogenic abscesses usually require percutaneous or surgical drainage. Fungal abscesses are usually multiple and occur in immunosuppressed individuals. Hydatid disease tends to be asymptomatic or present with biliary colic. Characteristic ultrasound scan features include daughter cysts and detachment of the endocyst, giving rise to 'floating membranes' within the cyst cavity.

25) A 43-year-old woman is incidentally found to have a well-defined, rounded, low-density, 2 cm lesion in the liver on unenhanced CT. Contrast-enhanced CT demonstrates peripheral nodular arterial enhancement with complete fill-in on delayed images. What is the most likely diagnosis?

- a. hepatic haemangioma
- b. hepatocellular carcinoma
- c. simple hepatic cyst
- d. focal fatty infiltration
- e. focal nodular hyperplasia

25) a. \*\*\*

**Haemangiomas** are the most common benign liver tumour. They are often asymptomatic but may present with hepatomegaly or rarely spontaneous haemorrhage. Typical CT features of a hepatic haemangioma are of a well-defined hypodense mass on unenhanced CT, with early peripheral enhancement after intravenous contrast followed by complete fill-in on delayed images. **Hepatocellular carcinoma** is seen as a hypodense mass and usually demonstrates contrast enhancement during the arterial phase, but enhancement decreases on delayed images. **Focal fatty infiltration** usually has a geographic distribution, and, like simple hepatic cysts, does not demonstrate contrast enhancement. **Focal nodular hyperplasia** is usually isodense on unenhanced CT and, although it tends to show intense transient arterial phase enhancement, is often isodense during the portal phase. A central scar, if present, may demonstrate enhancement on delayed images.



- 30) A 68-year-old man presents with acute abdominal pain. As well as other pathology, CT of the abdomen reveals multiple linear branching structures with an attenuation value of  $-1000$  HU in the liver extending to the periphery. What are these appearances most likely to represent?
- a. gas in the portal venous system
  - b. gas in the biliary tree
  - c. portal venous thrombosis
  - d. intrahepatic biliary dilatation
  - e. fatty infiltration of the liver

30) a. \*\*\*

**Portal venous gas** is identified on CT as linear branching structures of air density extending to the periphery of the liver, presumably due to the direction of portal venous flow. The **commonest cause in adults** is mesenteric infarction, when it is a poor prognostic sign. In infants the **commonest cause** is necrotizing enterocolitis, when it does not necessarily imply a poor outcome. **In contrast, gas within the biliary tree**

**is central and does not extend into the peripheral 2 cm of the liver.** In portal venous thrombosis, a focal hypodensity is seen within the portal vein on contrast-enhanced CT. Intrahepatic biliary dilatation appears as dilated branching ductal structures of fluid density. In fatty infiltration of the liver, vessels may appear hyperattenuating on unenhanced CT in contrast to the hypodense liver.

- 38) A 30-year-old woman on the oral contraceptive pill undergoes unenhanced CT of the abdomen, which demonstrates a well-circumscribed, slightly hypoattenuating mass in the liver. Which additional radiological finding would favour a diagnosis of hepatic adenoma rather than focal nodular hyperplasia?
- a. measured lesion size of 3 cm
  - b. accompanying acute subcapsular haematoma
  - c. transient arterial-phase enhancement
  - d. normal uptake on  $^{99m}\text{Tc}$ -labelled sulphur colloid scan
  - e. hypodense central stellate scar

38) b. \*\*\*\*\*

**Focal nodular hyperplasia (FNH)** is a benign hamartomatous malformation commonest in young women. Lesions are usually smaller than 5 cm, and contain a central stellate scar in up to one-third of cases. **Hepatic adenomas** are benign tumours averaging 8–10 cm in size, seen predominantly in young women and related to oral contraceptive use. Lesions have a propensity for spontaneous haemorrhage, presenting as subcapsular haematoma or haemoperitoneum. FNH, though highly vascular, rarely undergoes spontaneous haemorrhage. FNH usually contains sufficient functioning Kupffer cells to demonstrate normal or increased uptake on  $^{99m}\text{Tc}$ -labelled sulphur colloid scan, whereas hepatic adenoma, composed of hepatocytes and non-functioning Kupffer cells, appears as a focal photopenic lesion. Both lesions

demonstrate transient arterial enhancement following intravenous contrast.



- 39) A 25-year-old man presents with jaundice and malaise. Ultrasound scan demonstrates a general decrease in liver echogenicity and a well-distended gallbladder with a wall thickness of 4 mm. No gallstones are seen and the intra- and extrahepatic bile ducts appear normal. What is the most likely diagnosis?
- a. acute cholecystitis
  - b. cirrhosis
  - c. fatty liver
  - d. acute viral hepatitis
  - e. primary sclerosing cholangitis

39) d. \*\*\*

Acute hepatitis results in a diffuse decrease in liver echogenicity on ultrasound scan, with increased brightness of the portal triads resulting in a 'starry sky' appearance. Other imaging features include oedema of the gallbladder fossa and gallbladder wall thickening. Gallbladder wall thickening (anterior wall thickness  $> 3$  mm in a non-contracted gallbladder) may be seen in a wide range of intrinsic and extrinsic conditions. The commonest intrinsic cause is cholecystitis (acute and chronic), whereas common extrinsic causes include hepatitis, hypoalbuminaemia, heart failure and renal failure.

- 44) A 45-year-old patient with cirrhosis is found to have a focal liver lesion on ultrasound scan, clinically suspected to be hepatocellular carcinoma. What would be the expected appearances of the lesion on T2W MR images following infusion of superparamagnetic iron oxide particles?
- a. Increased signal intensity compared with rest of liver
  - b. decreased signal intensity compared with rest of liver
  - c. lesion signal intensity unchanged; rest of liver increased signal intensity
  - d. lesion signal intensity unchanged; rest of liver decreased signal intensity
  - e. no effect on appearances on T2W images

44) d. \*\*\*\*

Superparamagnetic iron oxide (SPIO) particles are iron-based particles of 30–150 nm, which, when administered as an infusion 1–4 hours prior to imaging, act as a negative MR contrast agent. They target the reticuloendothelial system, being taken up by macrophages throughout the body, but are preferentially accumulated by the Kupffer cells of the liver. Their superparamagnetic properties result in T2 and T2\*

shortening of the tissues that accumulate the particles, which show reduced signal intensity on T2W, T2\*W and, to a lesser extent, T1W images. Most liver tumours do not exhibit uptake, as they are deficient in Kupffer cells. However, as the rest of the liver accumulates SPIO and darkens preferentially, the tumour appears of increased conspicuity. SPIO particles are particularly used, in combination with gadolinium, to improve detection of hepatocellular carcinoma in cirrhotic patients, in whom the parenchymal changes of fibrosis and regenerative nodules make detection with gadolinium alone difficult.

45) A 35-year-old woman on the oral contraceptive pill presents with right upper quadrant pain, shortness of breath and leg oedema. Ultrasound scan of the abdomen demonstrates hepatosplenomegaly and ascites. The hepatic veins are not visualized on Doppler ultrasound scan. What is the most likely diagnosis?

- a. acute Budd–Chiari syndrome
- b. primary biliary cirrhosis
- c. passive hepatic congestion
- d. hepatic veno-occlusive disease
- e. viral hepatitis

45) a. \*\*\*

Budd–Chiari syndrome is caused by obstruction of hepatic venous outflow, which may, in turn, be caused by membranous obstruction of the suprahepatic IVC by a congenital web, or hepatic venous thrombosis due to hypercoagulable state, tumour or trauma. Patients develop hepatosplenomegaly and intractable ascites. Doppler ultrasound scan demonstrates non-visualization of, or thrombus within, one or more hepatic veins. CT findings reflect severely impaired blood flow to the liver, with a 'flip-flop' enhancement pattern after contrast administration. Early images show prominent central liver enhancement with poor peripheral enhancement, whereas delayed images show central washout with peripheral enhancement. The caudate lobe is typically spared because of its separate venous drainage directly into the IVC, and enhances normally. Passive hepatic congestion complicates heart failure, and results in distended hepatic veins and IVC. Hepatic veno-occlusive disease refers to occlusion of small centrilobular hepatic veins following radio- and chemotherapy in bone-marrow transplant recipients, or related to alkaloid consumption. The main hepatic veins and IVC are normal. Hepatic venous involvement is not a feature of viral hepatitis or primary biliary cirrhosis.

46) An 86-year-old, otherwise well woman is admitted with abdominal pain and undergoes plain abdominal radiography. This demonstrates a normal bowel gas pattern, but the liver and spleen are noted to be of increased density with a stippled appearance. What is the most likely cause?

- a. haemochromatosis
- b. thorotrastosis
- c. amiodarone therapy
- d. sickle cell anaemia
- e. glycogen storage disease



46) b. \*\*\*

Thorotrast (thorium dioxide), an alpha-emitting radioactive isotope of atomic number 90 and long half-life, was used as a contrast agent until the mid-1950s, predominantly for cerebral angiography and reticuloendothelial imaging. It is retained indefinitely by the reticuloendothelial system, and results in increased density of the liver, spleen and lymph nodes with a characteristic stippled appearance. It is associated with delayed malignancies, including angiosarcoma, cholangiocarcinoma and hepatocellular carcinoma. Haemochromatosis may result in diffusely increased density of the liver and spleen, but usually presents earlier in life. Amiodarone may result in increased liver attenuation of 95–145 HU (normal 30–70 HU), but splenic involvement is not usually a feature. Sickle cell anaemia can result in a shrunken calcified spleen, but again is unlikely in this age group. Glycogen storage disease can result in a generalized increase or decrease in hepatic density on CT, but increased splenic density is not a feature.

48) A 51-year-old man with alcoholic cirrhosis presents with jaundice. CT of the abdomen reveals an encapsulated, 20 mm focal area of low density in the liver, which demonstrates arterial-phase enhancement and rapid washout on delayed imaging. What is the most likely diagnosis?

- a. regenerative nodule
- b. dysplastic nodule
- c. hepatocellular carcinoma
- d. hepatic haemangioma
- e. focal fatty sparing

48) c. \*\*\*\*

Nodules are a common finding in cirrhosis, and differentiation of benign nodules from hepatocellular carcinoma (occurring in 7–12% of patients) is vital. Most nodules are **regenerative nodules**, representing reparative attempts by hepatocytes in response to liver injury. These are typically under 10mm in size and appear **isodense** to liver parenchyma on CT, unless they contain iron deposits (siderotic nodules), in which case they may be slightly hyperdense. **Dysplastic nodules** are proliferative premalignant lesions found in 15–25% of cirrhotic livers. They resemble regenerative nodules on CT but are usually larger than 10mm. **Hepatocellular carcinomas** usually appear as encapsulated hypodense masses that demonstrate rapid arterial enhancement and early washout of contrast on delayed images. **Hepatic haemangioma** usually appears as a low-density mass, but has different enhancement characteristics, demonstrating peripheral enhancement with complete fill-in on delayed images. **Focal fatty sparing** appears as an area of normal density in a generally hypodense liver and does not demonstrate contrast enhancement.

56) A 27-year-old woman presents with upper abdominal pain and is found to have a palpable right upper quadrant mass on examination. CT demonstrates a low attenuation lesion in the right lobe of the liver. Which imaging feature would favour a diagnosis of fibrolamellar carcinoma of the liver rather than focal nodular hyperplasia?

- a. calcifications within a central scar
- b. lesion size of 3 cm
- c. multiple lesions
- d. increased uptake on sulphur colloid scan
- e. central scar hyperintense on T2W images



56) a. \*\*\*\*

**Fibrolamellar carcinoma** of the liver is an uncommon variant of hepatocellular carcinoma, typically presenting as a large, 5–20 cm liver mass in a young patient with no risk factors. Typical features are of an encapsulated mass with a prominent central fibrous scar. The scar often contains areas of calcification, and appears hypointense on T1- and T2-weighted images. **Focal nodular hyperplasia (FNH)** is a hamartomatous malformation also most commonly seen in young woman. However, lesion size is usually <5 cm and, although a central fibrous scar is also a common feature, this usually appears hyperintense on T2-weighted images due to vascular channels and oedema, and calcifications within it are extremely rare. Both pathologies may result in multiple lesions, with FNH being multiple in 20% and fibrolamellar carcinoma demonstrating satellite lesions in 10–15%. FNH is the only liver lesion with sufficient Kupffer cells to cause normal or increased uptake on sulphur colloid scan.

58) A 45-year-old man undergoes ultrasound scan of the abdomen 2 days following orthotopic liver transplantation, which demonstrates periportal oedema and a small fluid collection at the hilum of the liver. What is the most likely diagnosis?

- a. graft rejection
  - b. hepatic arterial thrombosis
  - c. portal vein stenosis
  - d. bile leak
  - e. normal post-transplantation findings
- Answer: b*

58) e. \*\*\*\*

Orthotopic liver transplantation is the treatment of choice for patients with end-stage liver disease for which no other therapy is available. Surgery involves one arterial anastomosis (hepatic artery), at least two venous anastomoses (portal vein and IVC) and a biliary anastomosis, and complications may occur at any of these sites. Vascular complications are the most frequent cause of graft loss, and most commonly involve the hepatic artery, with portal venous and IVC complications being relatively infrequent. Biliary complications occur in up to 34% of cases, and are the second most common cause of liver dysfunction after graft rejection. They include leak, stricture and obstruction. Other complications include fluid collections, infection and malignancy. Normal findings following liver transplantation include a small amount of free intraperitoneal fluid in the perihepatic region, especially at the hilum, or in the fissure for the ligamentum teres, which usually resolves within a few weeks. Other normal findings are a right fluid pleural effusion, and periportal oedema, attributed to lymphatic channel dilatation due to lack of normal lymphatic drainage.

- 66) A 40-year-old man with hyperpigmentation, arthralgia and diabetes mellitus is clinically suspected to have primary haemochromatosis. What are the most likely findings on liver MRI in this condition?
- a. normal appearances of the liver
  - b. decreased signal intensity on T1W and T2W images
  - c. decreased signal intensity on T1W and increased signal intensity on T2W images
  - d. increased signal intensity on T1W and decreased signal intensity on T2W images
  - e. increased signal intensity on T1W and T2W images

66) b. \*\*\*

In primary haemochromatosis, there is increased duodenal absorption and parenchymal retention of dietary iron, which is accumulated within the liver, pancreas, heart and pituitary gland. Intracellular iron deposits within hepatocytes result in a paramagnetic susceptibility effect, leading to marked shortening of T1 and T2 relaxation times of adjacent protons.

This manifests as a marked reduction in liver signal intensity on T2W and T2\*W images, and a moderate loss of signal intensity on T1W images.

69) A 54-year-old woman undergoes CT of the abdomen and pelvis for weight loss and is found to have multiple, irregular, calcified, low-attenuation lesions in the liver, suggestive of metastases. What is the most likely primary lesion?

- a. invasive ductal carcinoma of the breast
- b. mucinous adenocarcinoma of the gastrointestinal tract
- c. osteosarcoma
- d. non-small-cell lung carcinoma
- e. carcinoid

69) b. \*\*\*

Calcified liver metastases represent up to 3% of liver metastases, and are most commonly seen with mucinous carcinomas of the gastrointestinal tract. They are also seen in osteosarcoma, breast cancer, lung cancer and carcinoid, but these are less common.



- 72) A 45-year-old woman undergoes abdominal ultrasound scan. The portal vein measures 16 mm in diameter and demonstrates continuous monophasic flow without respiratory variation. Portal vein flow velocity is hepatopetal and is measured to be 7 cm/s. What is the most likely diagnosis?
- a. normal findings
  - b. Budd–Chiari syndrome
  - c. portal hypertension
  - d. cavernous transformation of the portal vein
  - e. portal vein thrombosis

72) c. \*\*\*\*

The normal portal vein measures up to 13 mm in diameter when measured in the AP direction where the portal vein crosses the inferior vena cava during quiet respiration in a supine patient. Portal venous flow is normally 12–30 cm/s and demonstrates respiratory variation but little or no pulsatility, though this may be seen in thin patients. Normal flow is hepatopetal (anterograde flow into the liver). Portal hypertension is defined as an increase in portal venous pressure above 10 mmHg, and is most commonly caused by cirrhosis in the western world. As portal pressure increases, portal vein diameter increases, and portal flow loses its respiratory fluctuation and becomes slow and turbulent. Reversed (hepatofugal) flow may occur in 8% of patients and is generally associated with a reduced portal vein diameter. Other findings include portosystemic collaterals, splenomegaly and ascites. In portal vein thrombosis, portal vein diameter increases, but no flow is seen on

Doppler ultrasound scan. Echogenic thrombus may be seen within the lumen. Cavernous transformation of the portal vein may occur with chronic portal vein thrombosis, representing a conglomerate of collateral veins. Budd–Chiari syndrome affects the hepatic veins.

- 86) A 26-year-old man with AIDS presents with weight loss. He is noted to have multiple raised purple skin lesions on examination. Contrast-enhanced CT of the abdomen and pelvis demonstrates multiple, subcentimetre, low-attenuation nodules within the liver, as well as high-attenuation lymphadenopathy at the porta hepatis, retrocaval and aortocaval regions. What is the most likely diagnosis?
- a. fungal infection
  - b. multiple haemangiomas
  - c. lymphoma
  - d. Kaposi's sarcoma
  - e. mycobacterial disease

86) d. \*\*

Kaposi's sarcoma is a low-grade tumour of the blood and lymphatic vessels that primarily affects the skin but may cause disseminated disease in other organs. It is an AIDS-defining illness and is the most common AIDS-related neoplasm. The commonest manifestation is of multiple raised purplish skin lesions, but lymphadenopathy is the second commonest feature in AIDS-related Kaposi's sarcoma. Typical appearances are of abdominopelvic lymph nodes that enhance after intravenous contrast due to high vascularity, appearing to be of higher attenuation than skeletal muscle. Liver involvement occurs in 34% of cases at autopsy, and typically causes multiple 5–12mm nodules that are hyperechoic on ultrasound scan and of low attenuation on CT. Skin lesions are present in most cases, and help to distinguish Kaposi's sarcoma from other conditions such as fungal microabscesses and multiple haemangiomas, which may have similar appearances on CT. Mycobacterial disease is characteristically associated with low-attenuation lymphadenopathy. Non-Hodgkin's lymphoma is the second commonest AIDS-related neoplasm, and may cause multiple

low-attenuation liver lesions, but it is not associated with skin lesions or high-attenuation lymphadenopathy.



- 91) A 45-year-old woman undergoes a follow-up staging CT of the chest, abdomen and pelvis after treatment for metastatic breast cancer. Compared with her initial staging scan, there is a generalized decrease in the attenuation value of the liver. No focal liver lesion or other new feature is seen. What is the most likely cause?
- a. diffuse metastatic disease
  - ☒ b. fatty liver related to chemotherapy
  - c. hepatic venous congestion
  - d. amyloidosis
  - e. Budd–Chiari syndrome

91) b. \*\*\*

Chemotherapeutic agents are commonly associated with fatty liver. Diffuse fat deposition (the commonest pattern) causes a generalized decrease in the attenuation value of the liver on CT, and may be diagnosed with an absolute liver attenuation value of less than 40 HU on contrast-enhanced CT. It may also be diagnosed at unenhanced CT if the liver attenuation value is at least 10 HU less than that of the spleen. Liver metastases usually present as focal, low-attenuation lesions on portal phase imaging. Hepatic venous congestion causes a diffuse decrease in attenuation but is associated with enlargement of the inferior vena cava and hepatic veins due to elevated central venous pressure. Amyloidosis can cause a generalized decrease in liver attenuation, but more commonly appears as discrete areas of low attenuation with reduced contrast enhancement. Budd–Chiari syndrome may also result in a diffuse decrease in liver attenuation, but there is usually patchy liver enhancement and poor visualization of the hepatic veins.

9. An 83 year old woman is investigated for weight loss, and undergoes contrast-enhanced CT scan of the chest, abdomen and pelvis. Multiple hypervascular metastases are found in the liver. Which one of the following is most likely to be the primary tumour?
- a. Adenocarcinoma of the stomach
  - b. Invasive ductal carcinoma of the breast
  - c. Carcinoid tumour
  - d. Adenocarcinoma of the sigmoid
  - e. Pancreatic ductal adenocarcinoma

9. c. Carcinoid tumour

Of the options listed, carcinoid tumour is the only primary tumour that typically causes hypervascular liver metastases. Other causes of hypervascular liver metastases are pancreatic islet cell tumours, pheochromocytoma and renal cell carcinoma. Stomach, breast, lung and colon cancers are associated with hypovascular liver metastases. Liver metastases from carcinoid tumours are more common with increasing size of the primary tumour. The incidence of metastases depends on the location of the primary tumour, where approximately 30% of carcinoids of the ileum metastasise compared to less than 5% of carcinoids of the appendix.

### Hypervascular Liver metastasis

#### **CHIMP**

**C**arcinoid

**H**ypernephroma

**I**slet cell tumor

**M**elanoma

**P**heochromocytoma

## **Echogenic liver metastasis**

- Colonic carcinoma (mucinous adenocarcinoma)
- Hepatoma
- Treated breast carcinoma

16. An asymptomatic 46 year old woman has an MR liver following an incidental finding of a focal mass in the right lobe of the liver on ultrasound. The MR shows an 8 cm isolated lesion. It is high signal on T1-weighted sequences and isointense on T2-weighted sequences relative to the normal liver parenchyma. The lesion is most likely to be which one of the following?
- a. Hepatocellular carcinoma
  - b. Liver metastasis
  - c. Haemangioma
  - d. Fibronodular hyperplasia
  - e. Adenoma

### **16. e. Adenoma**

The lesion is most likely to be a hepatic adenoma. None of the other diagnoses typically share these imaging characteristics. Adenomas are benign growths of hepatocytes and are most commonly seen in young women, particularly associated with oral contraceptive use. Eighty per cent are solitary and found in the right lobe of the liver. The high signal on T1-weighted sequences is due to the presence of fat and/or haemorrhage and can distinguish between this and many other lesions in the liver which tend to be of low T1 signal on MR (e.g. metastases, HCC, haemangiomas and FNH). Occasionally, imaging features can overlap with FNH and the two lesions can be difficult to distinguish. However, the majority of FNH lesions are less than 5 cm in size, whereas adenomas tend to be larger.

17. A 26 year old female has an ultrasound scan for right upper quadrant pain and a heterogenous 5 cm solitary liver lesion with central calcifications, and a hyperechoic scar is seen. Blood tests reveal a negative alpha-fetoprotein. MR shows the lesion is hypointense on T1 and hyperintense on T2-weighted imaging. The central scar is hypointense on both sequences. Which of the following diagnoses is most likely?
- a. Hepatic lymphoma
  - b. Hepatocellular carcinoma
  - c. Fibrolamellar carcinoma
  - d. Hepatoblastoma
  - e. Hepatic angiosarcoma

17. c. **Fibrolamellar carcinoma**

Fibrolamellar carcinoma occurs in young adults in the absence of normal risk factors for hepatocellular carcinoma. On ultrasound, fibrolamellar carcinoma is of mixed or increased echogenicity, and the hyperechoic central scar is often evident. On unenhanced CT the lesion is of low attenuation, displaying heterogenous enhancement with intravenous contrast administration. The central scar is typically of low signal on both T1- and T2-weighted imaging, which can help differentiate it from FNH (whose scar typically is of low signal on T1 but high signal on T2-weighted imaging). The central scar is present in up to 60% of patients. Calcifications are present in up to 55% and are more common than in hepatocellular carcinoma.

28. A 53 year old male is investigated for recurrent episodes of biliary colic. Blood tests reveal eosinophilia and normal liver function tests. Abdominal ultrasound demonstrates a 7 cm cystic structure with a thin hyperechoic wall and several smaller satellite cysts up to 2 cm adjacent to the lesion. Which one of the following diagnoses is most likely?
- a. Hydatid cyst
  - b. Pyogenic abscess
  - c. Amoebic abscess
  - d. Schistosomiasis
  - e. Hepatocellular carcinoma



**28. a. Hydatid cyst**

The most likely diagnosis is hydatid cyst disease. This condition is caused by infection of the liver with the parasite *Echinococcus granulosus*. Blood eosinophilia is present in up to 50% of patients. It is more common in the right lobe of the liver and is multiple in 20% of cases. Daughter cysts are typical. Percutaneous aspiration of the cyst is positive for hydatid disease in 70%.

**37. A 52 year old male has an unenhanced CT KUB for left renal colic. No cause for the pain is discovered on the CT, however the liver is found to be of increased density relative to the spleen. Which one of the following would be most likely to explain this incidental finding?**

- a. Excess alcohol intake
- b. Amiodarone use
- c. Diabetes
- d. Steroids
- e. Past history of chemotherapy

**37. b. Amiodarone use**

The normal liver is between 30 and 70 HU on unenhanced CT, and should be 10–15 HU lower than spleen density. On portal venous phase the liver will be approximately 25 HU less than the spleen. Amiodarone contains iodine and can cause the liver to appear of increased density on CT. Other causes include cisplatin use, haemochromatosis, Wilson disease and glycogen storage diseases. The more common finding on CT is a liver of decreased density due to a fatty liver. This has many causes including alcohol use, steroids, chemotherapy, diabetes and nutritional causes.



43. A 42 year old woman undergoes a CT abdomen and pelvis for the investigation of right upper quadrant pain and deranged liver function tests. On early post-intravenous contrast images there is prominent enhancement of the central liver and weak enhancement of the peripheral liver. This pattern is reversed on delayed images. In addition there is hypertrophy of the caudate lobe. Which one of the following would most likely explain these findings?
- a. Acute hepatitis
  - b. Cirrhosis
  - c. Budd-Chiari syndrome
  - d. Portal hypertension
  - e. Fatty liver

43. c. Budd-Chiari syndrome

Budd-Chiari syndrome is outflow obstruction of the hepatic veins due to a wide variety of causes, but two-thirds are idiopathic. CT features include 'flip-flop' enhancement pattern as described in the question, ascites, hepatosplenomegaly, gallbladder wall thickening and increased portal vein diameter. An enlarged caudate lobe is seen in up to 88%, which enhances normally due its venous drainage passing directly into the IVC.

44. A 61 year old man undergoes CT abdomen and pelvis for characterisation of a well-defined hyperechoic area seen on ultrasound in the perihilar region of the liver. On CT the area is of decreased attenuation but has no obvious mass effect. There is no abnormal enhancement with intravenous contrast administration. Which one of the following diagnoses is most likely?
- a. Focal nodular hyperplasia
  - b. Focal fatty infiltration
  - c. Hepatic cyst
  - d. Liver haemangioma
  - e. Fibrolamellar carcinoma

**44. b. Focal fatty infiltration**

Focal fatty infiltration occurs typically in the periportal and centrilobar regions of the liver and is commonest adjacent to the falciform ligament. Ultrasound features include a hyperechoic area with geographic margins. CT shows an area of decreased attenuation which does not alter the course of blood vessels or liver contour. The lesions are of high signal on T1-weighted MR imaging, and isointense or low signal on T2-weighted imaging. Haemangiomas would also typically be of increased echogenicity on ultrasound, but would be expected to show increased peripheral enhancement with intravenous contrast on CT.

48. A 41 year old female has an MRI liver following a solitary 3 cm lesion in the right lobe of the liver. The lesion is isointense on T1-weighted and slightly hyperintense to liver parenchyma on T2-weighted imaging. There is immediate intense homogenous enhancement with gadolinium in the arterial phase, which becomes isointense on the venous phase. A central scar is hypointense on T1 and hyperintense on T2-weighted sequences. Which one of the following is the most likely diagnosis?

- a. Adenoma
- b. Cavernous haemangioma
- c. Fibrolamellar carcinoma
- d. Regenerative nodules
- e. Focal nodular hyperplasia

**48. e. Focal nodular hyperplasia**

These imaging features are typical of focal nodular hyperplasia. This is the second most common benign liver tumour and typically occurs in women more often than in men. Adenomas are usually larger, enhance less brightly and do not typically have a central fibrous scar. Cavernous haemangiomas are usually high signal on T2-weighted images, and of blood pool intensity on contrast-enhanced T1-weighted images. Fibrolamellar carcinoma also has a central scar, but this is typically of low signal intensity on T2-weighted imaging. Regenerative nodules show high signal intensity on unenhanced T1-weighted imaging and do not have a scar.

49. A 71 year old woman with no significant past medical history has an abdominal ultrasound as part of an investigation for right upper quadrant pain, anaemia and weight loss. Multiple, poorly defined, markedly echogenic lesions are seen throughout the liver. Biopsy reveals these to be metastases. Which one of the following is most likely to be the primary tumour?
- a. Adenocarcinoma of the colon
  - b. Melanoma
  - c. Invasive ductal carcinoma of the breast
  - d. Gastric cancer
  - e. Pancreatic ductal adenocarcinoma

49. a. Adenocarcinoma of the colon

The most common primary tumours that cause brightly echogenic liver metastases are colonic adenocarcinoma, treated breast cancer and hepatoma. The differential here therefore lies between breast cancer and colon cancer. Colon cancer makes up at least 50% of highly echogenic metastases. In addition the question states that the patient has no significant past medical history, and therefore treated breast cancer is unlikely.

51. A 25 year old female becomes unwell six hours after induced delivery for pre-eclampsia with severe right upper quadrant pain, oedema and nausea. CT of the abdomen and pelvis reveals copious ascites and multiple wedge-shaped areas of liver non-enhancement consistent with hepatic infarction. Which of the following is the most likely underlying cause?
- a. Hepatic artery embolus
  - b. Portal vein thrombosis
  - c. SVC occlusion
  - d. HELLP syndrome *⇒ Haemolysis, elevated liver enzymes & low platelets*
  - e. Splenic vein thrombosis

51. d. HELLP syndrome

Hepatic infarction is rare because of the dual blood supply to the liver via the hepatic arterial system and the portal venous system. Isolated pathology in either of these vascular supplies is unlikely to cause hepatic necrosis as the other supply will usually compensate. HELLP is characterised by haemolysis, elevated liver enzymes and low platelets and is one of the causes of liver infarction.

52. A 47 year old female with a history of surgery for breast carcinoma is referred for ultrasound after liver function tests show a mildly elevated alkaline phosphatase. The bile ducts are normal but a 3 cm hyperechoic liver lesion is seen in the right lobe. CT is recommended, which shows a focal mass with nodular hyperenhancement of the periphery on arterial phase imaging becoming isointense to the background liver on delayed phase scanning at five minutes. Which one of the following is the most likely diagnosis?

- a. Fibrolamellar carcinoma
- b. Adenoma
- c. Cavernous haemangioma
- d. Adenocarcinoma metastases
- e. Focal nodular hyperplasia

**52. c. Cavernous haemangioma**

Metastases may show peripheral enhancement with complete fill-in on delayed images, but they typically show complete rather than nodular peripheral enhancement and washout on delayed phase imaging. Only haemangiomas typically show peripheral nodular enhancement. Cavernous haemangiomas are the most common benign liver tumours and are usually less than 4 cm in size. Seventy per cent are hyperechoic on ultrasound and they may show acoustic enhancement.

53. A 33 year old female presents to A&E with right upper quadrant pain, hypotensive and tachycardic. CT abdomen and pelvis reveals an 11 cm diameter well-defined heterogeneous mass within the right lobe of the liver, predominantly of low density but with three focal areas of higher attenuation ( $>90$  HU) within it. There is layered high-attenuation fluid within the subhepatic and right subdiaphragmatic space tracking down to the pelvis. Which one of the following is the correct combination of recommendations?

- a. Adenoma – recommend surgical referral
- b. Adenoma – recommend correct coagulopathy and rescan if it deteriorates
- c. Adenoma – recommend endovascular embolisation
- d. Metastatic hepatocellular carcinoma – recommend gastroenterology referral
- e. Trauma – needs CT thorax to clear other injuries



53. c. Adenoma – recommend endovascular embolisation

Adenomas are vascular lesions comprising hepatocytes. They may occasionally present with massive haemorrhage, and are the most common liver lesion to do so in young people. In this scenario there is active extravasation of contrast implying active bleeding and haemoperitoneum. Urgent embolisation is the most appropriate treatment to halt bleeding. Conservative or surgical management is unlikely to provide rapid haemostasis. As a proportion of adenomas become malignant, they are usually removed surgically.

54. A 54 year old male has a liver MR for characterisation of a 3 cm low-attenuation lesion found on staging CT for rectal carcinoma. Which one of the following characteristics would be most worrying for a metastasis rather than a benign lesion?

- a. Peripheral washout on delayed imaging
- b. Intense arterial enhancement
- c. Peripheral nodular enhancement
- d. Presence of a pseudocapsule
- e. Low signal intensity on T1-weighted imaging

54. a. Peripheral washout on delayed imaging

Peripheral washout of contrast on delayed imaging is virtually diagnostic of malignancy. On post-gadolinium-enhanced T1-weighted images most metastases are hypovascular compared with the surrounding liver and are most conspicuous at the portal phase of enhancement. However, virtually all metastases exhibit a complete ring of peripheral enhancement, which is best seen in the early arterial phase.



55. A 63 year old male has a CT abdomen and pelvis for the investigation of change in bowel habit and weight loss. A sigmoid tumour is demonstrated and there is a solitary liver metastasis. Which one of the following observations on CT would render the patient ineligible for curative resection of the liver metastasis?
- a. Presence of a single peripheral left lower lobe pulmonary metastasis
  - b. Presence of splenic metastasis
  - c. Direct extension of the liver metastasis into the right adrenal gland
  - d. Involvement of the caudate lobe
  - e. Peritoneal metastases

**55. e. Peritoneal metastases**

Generally accepted contraindications to liver resection would include uncontrollable extrahepatic disease such as: non-treatable primary tumour; widespread pulmonary disease; locoregional recurrence; peritoneal disease; extensive nodal disease, such as retroperitoneal, mediastinal or portal nodes; and bone or CNS metastases. Patients with extrahepatic disease that should be considered for liver resection include: resectable/ablatable pulmonary metastases; resectable/ablatable isolated extrahepatic sites – for example, spleen, adrenal or resectable local recurrence; and local direct extension of liver metastases to, for example, the diaphragm or adrenal glands, which can be resected.

- 37 A diabetic 50-year-old man was investigated for hepatic disease. His liver was enlarged and he had hyperpigmentation of his skin. His serum iron was >300 mg/dL and serum transferrin saturation was >50%. What imaging feature is most characteristic of the underlying diagnosis?
- a Increase in hepatic echogenicity on US
  - b Patchy echogenicity demonstrated on US
  - c Decrease in hepatic T1 signal on MR
  - d Decrease in hepatic attenuation on CT
  - e Decrease in hepatic T2 signal on MR

37 Answer E: Decrease in hepatic T2 signal on MR

Haemochromatosis can be primary or secondary. The primary form shows autosomal recessive inheritance and usually presents after middle age, particularly in women where menstruation is protective. Hepatomegaly and hyperpigmentation are seen in 90%. Diabetes can occur in up to 30% secondary to pancreatic beta cell damage. Significant signal loss on T2WI is very characteristic.

- 39 Following a holiday in South-East Asia, a 33-year-old man presented with abdominal pain. Ultrasound demonstrated an echo-poor lesion within the right lobe of the liver which contained several smaller internal cysts. What is the most likely diagnosis?
- a Amoebic abscess
  - b *Echinococcus*
  - c Pyogenic abscess
  - d Polycystic liver disease
  - e Haemangioma

39 Answer C: *Echinococcus*

- 40 A 67-year-old woman noticed an abdominal mass and was referred for an ultrasound scan. This showed a large, uniformly hyperechoic mass in the left lobe of the liver. A subsequent multi-phase contrast-enhanced CT confirmed this mass which enhances peripherally until it becomes isoattenuating with the adjacent liver parenchyma after five minutes. What is the most likely diagnosis?
- a Adenoma
  - b Haemangioma
  - c Hepatocellular carcinoma
  - d Focal nodular hyperplasia
  - e Solitary metastasis

**40 Answer B: Haemangioma**

Hepatic haemangioma are the commonest benign liver tumours. They are typically hyperechoic on ultrasound and demonstrate centripetal enhancement with delayed 'fill-in' on contrast-enhanced CT. Enhancing focal liver lesions can be usefully characterised according to the phase of their enhancement. Other lesions that show delayed (equilibrium phase) enhancement include: cholangiocarcinoma, solitary fibrous tumour and treated metastases.

**41** A 38-year-old woman presented with upper abdominal discomfort. She was otherwise well and was taking the combined oral contraceptive pill. Physical examination was normal. An ultrasound showed a well-circumscribed, homogeneous 4-cm mass in the liver and she was subsequently referred for a liver MRI. What feature would be most useful in distinguishing focal nodular hyperplasia from adenoma?

- a Calcification
- b Internal haemorrhage
- c Multiple lesions
- d Uptake of reticuloendothelial contrast
- e Uptake of hepatobiliary contrast

**41 Answer E: Uptake of hepatobiliary contrast**

Reticuloendothelial contrast agents, such as Ferrioxan, carboxydextran-coated iron oxide nanoparticles (Resovist®) are taken up by both focal nodular hyperplasia (FNH) and adenoma. Hepatobiliary contrast agents, such as Gadolinium-Benzylxypropionic tetra-acetate (Gd-BOPTA or MultiHance®) are not taken up by adenoma.

- 42 A middle-aged man with symptoms of lethargy and painful hands presented to his doctor. Routine blood tests showed deranged liver function and plain radiographs of his hands showed an arthropathy primarily affecting the first and second metacarpophalangeal (MCP) joints. He was referred to a hepatologist and an abdominal CT was arranged. The liver was of diffusely increased density prior to contrast administration. What is the most likely underlying diagnosis?
- a Amiodarone treatment
  - b Glycogen storage disorder
  - c Haemochromatosis
  - d Primary biliary cirrhosis
  - e Rheumatoid arthritis

42 Answer C: Haemochromatosis

Causes of increased liver attenuation pre-intravenous contrast include: haemochromatosis, haemosiderosis, iron overload, glycogen storage disease and amiodarone treatment.

- 43 A 58-year-old African woman was visiting her grandchildren in London when she developed right upper quadrant pain. The local doctor, suspecting gallstones, arranged an ultrasound which showed a grossly cirrhotic liver with markedly hyperechoic septa separating areas of relatively normal liver. The scanning radiologist recognised this as a 'turtle back' appearance. What is the most likely underlying diagnosis?
- a Amoebiasis
  - b Hydatid
  - c Lymphoma
  - d Schistosomiasis
  - e Tuberculosis

43 Answer D: Schistosomiasis

The described ultrasound appearances are typical of schistosomiasis. Radiological features rarely develop until the late stages and are signs of cirrhosis and fibrosis. Patients are at a significantly increased risk of hepatocellular carcinoma (HCC).

- 44 A 17-year-old male developed upper abdominal pain and abdominal distension two days after an appendectomy. He had been dehydrated on presentation but the operation was uncomplicated. Transabdominal ultrasound showed a large volume of ascites and a diagnosis of portal vein thrombosis was considered. What sonographic finding is most commonly seen that would support this diagnosis?
- a Portosystemic collateral circulation
  - b Increase in portal vein diameter
  - c Echogenic material in the portal vein lumen
  - d Enlargement of a thrombosed portal vein above 15 mm
  - e Enlargement of the lesser omentum

44 Answer C: Echogenic material in the portal vein lumen

Echogenic material in the portal vein lumen (67%), increased in portal vein diameter (57%), portosystemic collateral circulation (48%), enlargement of a thrombosed portal vein above 15 mm (38%).

- 37 A 37-year-old male with known alcoholic liver disease causing severe cirrhosis and multiple previous admissions for gastrointestinal haemorrhage was recently treated with a transjugular intrahepatic porto-systemic shunt (TIPS). Unfortunately, he has developed encephalopathy as a result of decompensated liver disease and the gastroenterologist would like to know if the TIPS is patent. What is the most appropriate first-line investigation to determine this?
- a Ultrasound of the liver with Doppler
  - b Triple-phase intravenous contrast-enhanced CT
  - c Time of flight gadolinium-enhanced MR
  - d Fluoroscopy with venous catheter-based contrast injections
  - e Double-phase intravenous contrast-enhanced CT

37 Answer A: Ultrasound of the liver with Doppler

Doppler ultrasound is a reliable, non-invasive method in assessing shunt patency.



- 38 A 35-year-old male with protein C deficiency presented with a history of a few weeks of abdominal pain, increasing abdominal distension and jaundice. Biochemistry revealed grossly abnormal liver function tests and his coagulation was also markedly abnormal. An ultrasound demonstrated widespread ascites with hypertrophy of the caudate lobe and bicoloured flow in the hepatic veins on Doppler. What is the most likely diagnosis?
- a Acute Budd-Chiari syndrome
  - b Alcoholic liver disease
  - c Chronic Budd-Chiari syndrome
  - d Portal vein thrombosis
  - e Right heart failure

38 Answer C: Chronic Budd-Chiari syndrome

In acute Budd-Chiari syndrome the caudate lobe does not hypertrophy as it does in the chronic form (as it has separate drainage directly into the IVC). There are various causes of Budd-Chiari syndrome; 66% are idiopathic.

- 39 A young woman developed haematuria and was referred for a renal tract ultrasound. She was not on any medication other than the combined oral contraceptive pill. There were no positive renal tract findings, but while scanning the right kidney the ultrasonographer noticed a solitary isoechoic lesion in the right lobe of the liver. Following further assessment, the patient was referred for a contrast-enhanced MRI, primarily to discriminate between focal nodular hyperplasia (FNH) and adenoma. What radiological finding would support a diagnosis of FNH?
- a Internal haemorrhage
  - b Calcification
  - c Central scar
  - d Poor uptake of hepatobiliary liver contrast (Gd-BOPTA)
  - e Uptake of reticuloendothelial liver contrast

39 Answer C: Central scar

- 40 A 42-year-old man with known alcohol-related cirrhosis was assessed in the Hepatology outpatient clinic. Blood samples were taken for serum bilirubin, albumin and prothrombin time and evidence of hepatic encephalopathy was sought clinically. An abdominal ultrasound was requested to complete Child-Pugh cirrhosis scoring. What feature of ultrasound is used to complete the Child-Pugh score?
- a Ascitic fluid
  - b Collateral vessel formation
  - c Portal venous flow
  - d Splenomegaly
  - e Varices

40 Answer A: Ascitic fluid

The Child-Pugh score is derived from bilirubin and albumin levels, prothrombin time, hepatic encephalopathy and presence ascites.

- 41 An adult patient presented with non-specific symptoms suggestive of malignancy and an abdominal ultrasound showed multiple 'target-lesions' throughout the liver consistent with hepatic metastatic deposits. Without knowing the patient's age or gender, what is the most likely site of the primary tumour?
- a Breast
  - b Colorectal
  - c Bronchogenic
  - d Pancreatic
  - e Gastric

41 Answer B: Colorectal

Colorectal > Gastric > Pancreatic > Breast > Lung

- 42 A gap-year student returned from a long trip to Africa having experienced a few episodes of bloody diarrhoea. She then developed increasingly severe right upper quadrant pain and was referred for an abdominal ultrasound. This showed a solitary 8-cm, hypoechoic thin-walled lesion in the right lobe of the liver. Subsequent percutaneous drainage yielded reddish brown thick fluid. What is the most likely causative organism?
- a *Echinococcus* sp.
  - b *Entamoeba histolytica*
  - c *Escherichia coli*
  - d *Schistosoma* sp.
  - e *Staphylococcus aureus*

42 Answer B: *Entamoeba histolytica*

Amoebic abscesses typically present as a large solitary lesion in the right lobe of the liver. The contents have been described as 'anchovy paste' or 'chocolate sauce'.

- 44 A 17-year-old Greek boy presented with abdominal pain. He was of short stature but otherwise of normal physical appearance. Blood tests showed a microcytic anaemia and abnormal liver function tests. On ultrasound his liver measured 18 cm in cranio-caudal length; in the right mid-clavicular line his spleen measured 15 cm in longest axis. Gallstones were also noted in an otherwise normal gallbladder. What is the most likely diagnosis?
- a Sarcoidosis
  - b Glycogen storage disease
  - c Beta-thalassaemia
  - d Recent viral infection
  - e Leukaemia

44 Answer C: Beta-thalassaemia

All the options are causes of hepatosplenomegaly. Beta-thalassaemia is more common in the Mediterranean population and can cause microcytic anaemia and abnormal liver function. Affected patients are at increased risk of developing gallstones.

- 37 A middle-aged female underwent an abdominal ultrasound which demonstrated an area of increased reflectivity within the right lobe of her liver. She has no significant past medical history and a benign haemangioma is suspected. Were she to have an MRI what would the most likely signal characteristics of this lesion be?
- a Hypointense T1 and hyperintense T2
  - b Hypointense T1 and hypointense T2
  - c Hyperintense T1 and hyperintense T2
  - d Hyperintense T1 and hypointense T2
  - e Hyperintense T1 and isointense T2

37 Answer A: Hypointense T1 and hyperintense T2

- 39 Which of the following is an expected normal finding following liver transplant?
- a Hepatic arterial resistive index  $<0.5$
  - b Hepatic infarction
  - c Increased periportal attenuation
  - d Periportal lymphadenopathy
  - e Portal vein thrombosis

39 Answer C: Increased periportal attenuation

- 40 A focal liver abnormality was detected in a middle-aged man and he subsequently underwent a liver MRI to further delineate the lesion. The MRI showed the lesion to be hyperintense on T1-weighted sequences and hypointense on T2-weighted sequences. What lesion is most likely to exhibit this pattern of signal return?
- a Adenoma
  - b Regenerative nodule
  - c Focal nodular hyperplasia
  - d Haemangioma
  - e Metastases

40 Answer A: Adenoma

Most focal liver lesions are hypointense on T1WI. Exceptions to this rule include: adenoma, fatty lesions, blood, proteinaceous material, melanoma metastases and contrast agents.

41 A patient with a known colorectal carcinoma was being investigated for possible liver metastases. What modality is most sensitive in detecting liver metastases?

- a Contrast-enhanced CT
- b ERCP
- c MRI
- d FDG PET-CT
- e Ultrasound

41 Answer C: MRI

Sensitivity for detection of liver metastases: MR > CECT > FDG PET-CT.

42 A middle-aged man, known to have acute leukaemia, was referred for an abdominal ultrasound. Several small, uniformly hypoechoic nodules were visible within the liver, which were thought to represent foci of hepatic candidiasis and resolved following empirical treatment with antifungal drugs. Via what route is it most likely that the fungal infection spread to the liver?

- a Biliary ducts
- b Hepatic artery
- c Percutaneous
- d Portal vein
- e Transcoelomic

42 Answer B: Hepatic artery

Unlike pyogenic and amoebic infections, which usually enter the liver via the biliary ducts or portal vein, fungal infections typically enter via the hepatic artery.



- 43 A 30-year-old man with known polycythaemia rubra vera was referred for contrast-enhanced CT for investigation of progressive abdominal distension and jaundice. This showed ascites, caudate and right hepatic lobar hypertrophy with mosaic enhancement of the liver. There was also a low attenuation 2-cm lesion in segment 2 which showed peripheral nodular enhancement. A delayed phase scan showed filling in of the segment 2 lesion, but the remaining liver enhancement was markedly delayed. What is the most likely diagnosis?
- a Hepatocellular carcinoma
  - b Liver metastases
  - c Cirrhotic liver disease
  - d Budd-Chiari syndrome
  - e Alcoholic hepatitis

43 Answer D: Budd-Chiari syndrome

- 45 In a normal unenhanced CT scan of the upper abdomen, the liver parenchyma measures 65 HU. What would be the expected density of the spleen?
- a 20–30 HU
  - b 40–60 HU
  - c 65 HU
  - d 70–80 HU
  - e 100–120 HU

45 Answer B: 40–60 HU

Unenhanced CT spleen approximately 40–60 HU, and 5–10 HU less than liver.

- 70 A four-month-old child presented with hyperpigmented wheal and flare skin lesions. An abdominal ultrasound showed hepatosplenomegaly and some enlarged retroperitoneal lymph nodes. Examination of the bowel showed ileal wall thickening and further investigations showed distorted thickened nodular folds in the ileum. What is the most likely diagnosis?
- a Carcinoid
  - b Down syndrome
  - c Mastocytosis
  - d Pheochromocytoma
  - e Trisomy 18

70 Answer C: Mastocytosis

Mastocytosis is a systemic disease where there is mast cell proliferation. Over 50% present before six months old. Urticaria pigmentosa is seen in up to 90% and disease is seen in the skeletal, reticuloendothelial and abdominal systems.

11. **A lesion is noted in the liver on CT and ultrasound. It is inferior, anterior, and to the left of the right hepatic vein, but to the right of the middle hepatic vein. It is inferior of the confluence of the right and left portal veins. According to the Couinaud system, what segment of the liver is the lesion in?**
- A. Segment 4b.
  - B. Segment 5.
  - C. Segment 6.
  - D. Segment 7.
  - E. Segment 8.

11. **B.** Segment 5.

For a review of the segmental anatomy of the liver, please see the reference below.

Dahnert W. *Radiology Review Manual*, 6th edn, Lippincott Williams & Wilkins, 2007. p. 684.

**12. A 56-year-old male patient is referred for an ultrasound of abdomen prior to undergoing an anterior resection for a proximal rectal carcinoma. The ultrasound reveals a 2cm lesion in the right lobe of the liver, which is hyperechoic centrally with a hypoechoic rim. Which one of the following cannot be considered in the differential for this lesion?**

- A. Metastases.
- B. Haemangioma.
- C. Sarcoid.
- D. Candidiasis.
- E. Lymphoma.

**12. B. Haemangioma.**

The ultrasound findings describe a target lesion or bull's eye lesion. Cavernous haemangiomas can have unusual appearances, but a small lesion such as described will normally have a uniform hyperechoic appearance. Of all the other lesions described, metastasis would be top of the differential, although this appearance is not the most classical for a colonic metastasis.

**23. A 40-year-old female undergoes MRI of the liver, which demonstrates a 5-cm lesion that is isointense to liver on T1WI and slightly hyperintense on T2WI. It has a central scar that is hypointense on T1WI and hyperintense on T2WI. On contrast-enhanced dynamic MRI, the lesion is hyperintense in the arterial phase, and isointense to liver in the portal venous phase with delayed filling in of the central scar. What is the diagnosis?**

- A. Hepatic adenoma.
- B. Fibrolamellar hepatoma.
- C. Hypervascular metastasis.
- D. Focal nodular hyperplasia (FNH).
- E. Giant haemangioma.

**23. D. Focal nodular hyperplasia (FNH).**

This is the second most common benign liver tumour. It is thought to represent a hyperplastic response of hepatocytes to an underlying vascular malformation. It is most common in young adult females and is usually an asymptomatic solitary lesion. On histology, FNH consists of hyperplastic hepatocytes and small bile ductules around a central scar. The bile ductules of FNH do not communicate with the adjacent biliary tree. At ultrasound, FNH is isoechoic or hypoechoic. Colour Doppler may show prominent central vascularity. At CT, FNH is typically slightly hyperattenuating or isoattenuating to surrounding liver on precontrast images. On post contrast images, FNH is hyperattenuating in the arterial phase and isoattenuating in the portal venous phase with hypoattenuating central scar. The scar shows delayed enhancement. At MRI, FNH is iso- to hypointense on T1WI and slightly hyper- to isointense on T2WI. The central scar is hypointense on T1WI and hyperintense on T2WI. The enhancement pattern is similar to that on CT. If the appearances are atypical, MRI with hepatocyte-specific contrast agent (gadobenate dimeglumine) may be useful in confirming the hepatocellular origin of the mass. With gadobenate dimeglumine, FNH is iso- to hyperintense on the 1–3 hour delayed images in over 96% of cases.

**25. A 45-year-old female is suspected to have focal areas of fat infiltration on ultrasound of the liver. An MRI of the liver is requested for further assessment. What sequences are most useful in confirming the diagnosis of focal fat infiltration?**

- A. T1WI pre and post gadolinium.
- B. T1WI and T2WI.
- C. T1WI and fat-saturated T2WI.
- D. Dual GET1WI in phase and out of phase.
- E. MR spectroscopy.

**25. D. Dual GET1WI in phase and out of phase.**

Three basic MRI techniques are available for fat detection, which work on the basis of the difference in precessional frequency between water and fat protons. These are chemical shift imaging, frequency-selective imaging, and MR spectroscopy. Dual GET1WI is the most useful sequence in clinical practice. It is based on the phase interference effect or chemical shift imaging of the second kind. When the fat and water protons are in phase there is constructive interference and when they are out of phase there is destructive interference. By comparing the signal intensities on the in-phase and out-of-phase images, fat detection is possible.

Chemical shift imaging of the first kind, or chemical shift spatial misregistration, occurs at fat–water interfaces in the frequency-encoding direction, manifesting as alternating bands of high and low signal. It is present in all standard non-fat-saturated sequences, but it can be subtle and may be missed or mistaken for image noise. Frequency-selective imaging with selective excitation or saturation depends on the homogeneity of the magnetic field and the size of the lesion.

MR spectroscopy is too time-consuming for routine clinical use.



**29. A 55-year-old female with cirrhosis undergoes MRI of the liver, which demonstrates multiple small nodules that are hypointense on T2WI and enhance following administration of gadolinium in the arterial and portal venous phase. The nodules demonstrate uptake of hepatocellular agent and super paramagnetic iron oxide (SPIO) particles. What is your diagnosis?**

- A. Multifocal hepatocellular carcinoma (HCC).
- B. Siderotic nodules.
- C. Dysplastic nodules.
- D. Regenerative nodules.
- E. Multiple arterio-venous shunts.

**29. D. Regenerative nodules.**

Regenerative nodules are formed in response to necrosis and altered circulation. They remain enhanced in the portal venous phase as opposed to HCC, which typically demonstrates contrast washout in the portal venous phase. Regenerative nodules have normal hepatocellular function and Kupffer cell density and therefore demonstrate uptake of both hepatocellular agents and SPIO particles. As dedifferentiation proceeds, the hepatocellular function and Kupffer cell density reduce.

**30. A 62-year-old male with acute myocardial infarction develops abdominal discomfort and deranged liver function tests. A CT scan of the abdomen demonstrates heterogeneous liver enhancement, poor enhancement of the hepatic veins and inferior vena cava (IVC), ascites and bibasal pleural effusions. What additional feature would favour a diagnosis of passive hepatic congestion instead of acute Budd–Chiari syndrome?**

- A. Flip-flop enhancement pattern of the liver.
- B. Absent flow in hepatic veins.
- C. Dilated hepatic veins and IVC.
- D. Enlarged caudate lobe.
- E. Hepatomegaly.



**30. C. Dilated hepatic veins and IVC.**

Elevated right atrial/central venous pressure due to cardiac decompensation results in impaired venous drainage from the liver, producing passive hepatic congestion. If prolonged, passive hepatic congestion can result in cardiac cirrhosis. On CT imaging, retrograde enhancement of dilated IVC and hepatic veins is seen in the arterial phase. In the portal venous phase, there is delayed/reduced enhancement of the hepatic veins due to impaired venous drainage. There is heterogeneous enhancement of the liver parenchyma due to venous stasis. Other features of cardiac failure may be evident.

Acute Budd–Chiari syndrome is characterized by narrowed hepatic veins and intrahepatic IVC (secondary to compression by the enlarged liver) and by flip-flop pattern of enhancement between the arterial and the portal venous phases.

**31. A 47-year-old male patient undergoes an MRI examination for further characterization of an adrenal lesion. Axial gradient T1 in- and out-of-phase sequences confirm the benign nature of the adrenal lesion. Incidentally, the liver and pancreas demonstrate a signal drop on the in-phase images compared to out-of-phase images. What is your diagnosis and what additional sequence would confirm the diagnosis?**

- A. Diffuse fatty infiltration. GE T2WI.
- B. Diffuse fatty infiltration. SE T2WI.
- C. Haemochromatosis. SE T2WI.
- D. Haemochromatosis. GE T2WI.
- E. Haemosiderosis. GE T2WI.
- F. Haemosiderosis. SE T2WI.

**31. D. Haemochromatosis. GE T2WI.**

A dual GE T1 in- and out-of-phase sequence is routinely used in identifying lipid content within an adrenal lesion. It is based on the phase interference effect. When the fat and water signals are in-phase, there is constructive interference and when they are out-of-phase there is destructive interference. This results in signal drop-off on the out-of-phase sequence.

The reverse effect of decreased signal intensity on in-phase images compared to out-of-phase ones is seen in iron deposition diseases. This is because the echo time for the in-phase sequence is longer than for the out-of-phase sequence, therefore the in-phase sequence is more susceptible to the paramagnetic (dephasing) effects of iron.

**Haemochromatosis** is an autosomal recessive genetic disorder. There is abnormal deposition of iron in parenchymal organs such as the liver, pancreas, heart, etc.

In **haemosiderosis or secondary haemochromatosis**, iron deposition is seen in the reticuloendothelial system of the liver, spleen, and bone marrow. This type of deposition is not associated with tissue damage.

A GET2 sequence demonstrates signal loss due to the magnetic field inhomogeneity produced by the paramagnetic effects of iron. GE sequences are more susceptible to the paramagnetic effects than SE sequences, as there is no  $180^\circ$  rephasing pulse in gradient sequences.

**37. A 50-year-old male undergoes MRI of the liver for further characterization of a suspected haemangioma on ultrasound. In addition to the haemangioma, a peripheral wedge-shaped area of enhancement is seen in the arterial phase but no abnormality is seen in the corresponding area in the non-contrast or portal venous phases. What is the diagnosis?**

- A. Hepatocellular carcinoma.
- B. Hepatic infarct.
- ☒ C. Transient hepatic intensity difference (THID).
- D. Hypervascular metastasis.
- E. Haemangioma.

**37. C. Transient hepatic intensity difference (THID).**

THID on MRI or transient hepatic attenuation difference (THAD) on CT is a pseudolesion caused by focal alteration in the haemodynamics of the liver due to either non-tumourous arterio-portal shunt or obstruction of distal portal venous flow. THID or THAD is seen as a focal area of enhancement in the arterial phase only, with no abnormality seen in the portal venous phase. Features suggestive of THID or THAD include peripheral location, wedge shape, straight margins, and normal vessels coursing through the area.



**51. A 50-year-old male patient is admitted with congestive cardiac failure and undergoes a CT scan of the abdomen, which shows tortuous and prominent intrahepatic and extrahepatic arterial branches with early filling of dilated hepatic veins and IVC. The arterial phase scan shows mosaic perfusion with multiple enhancing foci. In the portal venous phase there is homogenous enhancement of the liver, with the prominent hepatic veins and IVC noted. What is the diagnosis?**

- A. Passive hepatic congestion.
- B. Budd–Chiari syndrome.
- C. Osler–Weber–Rendu syndrome.
- D. Multifocal transient hepatic attenuation differences.
- E. Von Meyerburg complex.

**51. C. Osler–Weber–Rendu syndrome.**

Osler–Weber–Rendu syndrome or hereditary haemorrhagic telangiectasia (HHT) is a rare autosomal dominant multisystem vascular disorder characterized by angiodysplastic lesions in which there is communication between arteries and veins of varying sizes. It commonly affects the skin, lungs, and mucous membranes but any organ system may be involved.

The liver is the most common site of abdominal HHT. Lesions range from tiny telangiectases to transient perfusion abnormalities and large confluent vascular masses. Coronal maximum intensity projection (MIP) images are useful in appreciating telangiectases.

Liver involvement is associated with arterio-venous shunting, porto-venous shunting, or both, resulting in hyperdynamic circulation, which may lead to high-output cardiac failure.

Budd–Chiari syndrome is hepatic vein thrombosis and Von Meyerburg complex is multiple biliary hamartomas.

**65. You have been asked to give a presentation on MRI of the liver to your radiological colleagues. One of the audience asks if any of the contrast agents used in MRI of the liver works best with any sequence other than a T1WI sequence. What do you respond?**

- A. Yes, gadopentate dimeglumine.
- B. Yes, mangafodipir trisodium.
- C. Yes, gadobenate dimeglumine (hepatocyte specific).
- D. Yes, SPIO.
- E. No, all liver contrast agents work best with T1WI.

**65. D. Yes, SPIO.**

Gadolinium chelates are extracellular agents. Gadolinium shortens the T1 relaxation time of adjacent water protons, resulting in signal enhancement on T1WI. It can be used for lesion detection, characterization, and liver vasculature assessment. Gadopentate dimeglumine (Magnevist®) is a commonly used extracellular agent.

SPIO particles are reticulo-endothelial agents that are phagocytosed by Kupffer cells. SPIO causes local magnetic field inhomogeneity and T2 and T2\* shortening, resulting in signal loss on T2WI and T2\*WI. Most liver tumours, including HCC, are deficient in Kupffer cells (cf. focal nodular hyperplasia) therefore after administration of SPIO the tumour appears hyperintense relative to the background liver.

Mangafodipir trisodium (Teslascan®) is a manganese-based hepatocyte specific agent that increases the signal intensity of the liver, bile ducts, and some hepatocyte-containing lesions (e.g. FNH) at T1WI. Similarly, gadobenate dimeglumine (Multihance®) is a gadolinium-based hepatocyte specific agent, which also works best with T1WI due to the T1 shortening effects of gadolinium.

**70. A 55-year-old male liver transplant recipient undergoes Doppler ultrasound assessment at 1 year for deranged liver function tests. Colour Doppler imaging demonstrates a stenosis in the hepatic artery, at the presumed anastomosis. Which of the following statements with regard to the associated pulsed Doppler findings is likely to be false?**

- A. Tardus-parvus arterial waveform distal to the stenosis.
- B. Resistive index of 0.9 distal to the stenosis.
- C. Spectral broadening in the immediate post-stenotic portion.
- D. Elevated peak systolic velocity at the stenosis.
- E. Elevated end diastolic velocity at the stenosis.

**70. B.** Resistive index of 0.9 distal to the stenosis.

Knowledge of the vessel 'waveform signature' and stenosis flow dynamics is essential in interpreting the Doppler findings. The hepatic artery is a low resistance vessel with continuous antegrade flow during systole and diastole. Generally, low-resistance arteries have a resistive index (RI) of 0.55–0.7. RIs higher or lower than this range are abnormal. RI is calculated by using the formula  $RI = (\text{peak systolic velocity} - \text{end diastolic velocity}) / \text{peak systolic velocity}$ . Most modern ultrasound machines calculate this automatically.

A stenosis results in increased arterial resistance to the blood flow proximal to the stenosis. This causes a reduction in the end diastolic velocity disproportionately more than the peak systolic velocity, producing a high-resistance waveform and high RI (due to a greater difference between the peak systolic and end diastolic velocities). This finding is not specific to stenosis and may be seen in the postprandial state, and in patients of advanced age and diffuse peripheral microvascular disease or compression (cirrhosis, hepatic venous congestion, cold ischaemia, and any stage of transplant rejection).

At and immediately distal to the stenosis there is turbulent flow and a jet phenomenon resulting in an increase in the peak systolic and end diastolic velocity and spectral broadening. Depending on the severity of the stenosis, the artery distal to the stenosis demonstrates the following findings: tardus-parvus waveform that refers to the late and low systolic peak (i.e. increased acceleration time and reduced peak systolic velocity). Low RI due to a greater reduction in peak systolic velocity compared to the end diastolic velocity.

Low RI may also be seen with distal vascular shunts (trauma, iatrogenic, cirrhosis, Osler–Weber–Rendu syndrome).

**71. A 50-year-old male with a 2.5-cm hepatocellular carcinoma undergoes RFA. Which of the following findings is uncommon in the immediate post-ablation period?**

- A. Transient peri-ablational hyperaemia.
- B. Small number of tiny intra-lesional air bubbles.
- C. Arterio-portal shunting.
- D. Ablation zone larger than the primary lesion.
- E. 'Mural nodule in cyst' pattern.



**71. E. 'Mural nodule in cyst' pattern.**

RFA produces thermally-induced coagulation necrosis, which manifests usually as an oval or round defect on contrast-enhanced CT. The ablation zone is slightly larger than the actual lesion to achieve curative treatment and prevent local recurrence, which is usually seen at the margins of the ablation zone. The following findings are common in the immediate post ablation period: transient peri-ablational hyperaemia, tiny air bubbles, and arterio-portal shunting.

A 'mural nodule in cyst' indicates the development of a biloma as a complication of RFA. This is usually seen several months after treatment. It is associated with interval enlargement of the RFA zone.

- 5) A 47 year old man undergoes a CT and subsequently an MRI. These show an area of focal fat accumulation adjacent to the falciform ligament anteriorly.**

**This may be attributed to flow within which of the following?**

- (a) Vein of Sappey
- (b) Cholecystic vein
- (c) Right gastric vein
- (d) Anterior gastric vein
- (e) Inferior epigastric vein

**5 (a)**

This is a common aberrant vein which drains the superior epigastric vein and/ or the internal thoracic veins and communicates with the left portal vein branches.

**6** A 61 year old man has alcohol-related chronic liver disease. Which of the following conditions is he not at increased risk of developing compared with the general population?

- (a) Non-specific interstitial pneumonitis
- (b) Bacterial pneumonia
- (c) Hydrothorax
- (d) Pulmonary hypertension
- (e) Acute respiratory distress syndrome

**6 (a)**

There is no increased risk of NSIP or any other interstitial lung disease as a result of cirrhosis. Patients with cirrhosis have altered immunity and undergo changes to the vascular bed both within the liver and the lungs.

**17** An unenhanced CT of the liver is performed. The liver has a density of 60 HU and the spleen has a density of 50 HU.

How might you account for these findings?

- (a) Normal findings
- (b) Diffuse fatty infiltration
- (c) Haemochromatosis
- (d) Wilson's disease
- (e) Budd-Chiari syndrome

**17 (a)**

The normal liver has a density of 50–70 HU. Fatty infiltration will reduce this as the atomic numbers of the elements C, H and O are low. Iron and copper deposition can raise the density, as they have high atomic numbers.

- 19 A 50 year old man undergoes liver transplantation. A routine follow-up liver US comments that the intra-hepatic arterial Doppler has a low resistance index (0.48) and a prolonged systolic acceleration time.**

**What diagnosis does this suggest?**

- (a) Hepatic artery stenosis
- (b) Portal vein occlusion
- (c) Hepatic artery pseudoaneurysm
- (d) Graft rejection
- (e) Hepatic artery thrombosis

**19 (a)**

The tardus et parvus waveform described here is seen distal to a stenosis. At the stenosis, a jet phenomenon may be seen with greatly increased flow.

- 20 A patient with liver disease is referred for US assessment of their TIPS stent which has been in situ for 3 months. The Doppler study demonstrates a flow rate of 2.3 m/s.**

**What is this most likely to represent?**

- (a) Normal flow
- (b) Arterio-venous fistula
- (c) Stent stenosis
- (d) Stent fracture
- (e) Stent occlusion

**20 (c)**

This is a jet phenomenon at a narrow stenosis. Normal flow rates are 0.5-1.9m/s but may vary with respiration.

- 31 A patient is referred for the investigation of right upper quadrant pain. US has equivocal findings and a HIDA examination is requested. At 35 minutes, there is little uptake within the liver, but renal excretion is noted.

**What is the most likely cause for these findings?**

- (a) Poor liver function
- (b) Acute cholecystitis
- (c) Poor renal function
- (d) Sphincter of Oddi dysfunction
- (e) Chronic cholecystitis

**31 (a)**

Liver uptake should be seen within 10 minutes. Thereafter, there is filling of the gallbladder and subsequent excretion to the bowel. Cholecystitis impairs uptake to the GB.

- 39 Hepatocellular adenomas are not associated with which of the following?

- (a) Spontaneous rupture
- (b) Oral contraceptive pill
- (c) Hepatocellular carcinoma
- (d) Androgenic steroids
- (e) Cholangiocarcinoma

**39 (e)**

Hepatocellular adenomas are uncommon benign tumours which comprise hepatocytes with no portal tracts or bile ducts. They are associated with the oral contraceptive pill and androgenic steroids. On imaging, they may have a scar or a pseudocapsule and enhance avidly in the arterial phase which can make differentiation from FNH difficult. There is a tendency to bleed or rupture, whilst 1% are thought to transform in to malignant lesions (HCC).

- 48 A 28 year old man with cystic fibrosis and abnormal liver function is referred to you for liver imaging by his clinical team.**

**Which of the following are not associated with cystic fibrosis?**

- (a) Nodular regenerative hyperplasia
- (b) Steatosis
- (c) Sclerosing cholangitis
- (d) Cirrhosis
- (e) Cholelithiasis

**48 (a)**

Cystic fibrosis produces a range of abnormalities, which may lead to fibrosis, cirrhosis and portal hypertension. A micro-gallbladder is also seen commonly.

- 2 A 42 year old woman presents with acute right upper quadrant pain and abdominal distension. She has a 1-week history of dark urine, particularly in the mornings, and is found to have pancytopenia.**

**What is the most likely diagnosis?**

- (a) Acute cholecystitis
- (b) Acute pyelonephritis
- (c) Budd-Chiari syndrome
- (d) Ruptured renal cell carcinoma
- (e) Infectious mononucleosis

**2 (c)**

The patient has classical features of underlying paroxysmal nocturnal haemoglobinuria (PNH), which predisposes to Budd-Chiari syndrome. Budd-Chiari syndrome presents with these symptoms; the severity of the initial liver disease is variable depending upon the extent of venous occlusion.



- 3 An MRI liver report reads: "There is a hyperintense lesion on T2-weighted imaging, which is hypointense on T1-weighted images. Following administration of *i.v.* Gadolinium, there is peripheral nodular enhancement in the arterial phase with progressive enhancement on the portal venous and delayed phases."

**What is the most likely diagnosis?**

- (a) Haemangioma
- (b) Cyst
- (c) Focal nodular hyperplasia
- ☒ (d) Hepatocellular adenoma
- (e) Hepatocellular carcinoma

3 (a)

These are characteristic findings of a haemangioma. A cyst will not enhance; FNH and adenoma are benign hypervascular lesions that equilibrate in the portal phase. HCC is hypervascular with washout on delayed imaging; the liver is usually cirrhotic.

- 13 A 33 year old woman undergoes an MRI study to characterise a 4 cm focal liver lesion found incidentally on US. The lesion is isointense to liver on T1 and T2-weighted images, enhances homogeneously and avidly in the arterial phase and is isointense in the portal venous and delayed phases. 1 hour after the administration of contrast medium (Gd-Bopta), the lesion is hyperintense to liver.

**What is the most likely diagnosis?**

- (a) Haemangioma
- (b) Focal nodular hyperplasia
- (c) Hepatocellular adenoma
- (d) Fibrolamellar hepatocellular carcinoma
- (e) Metastasis

**13 (b)**

These imaging features are characteristic of FNH. FNH is a benign tumour thought to represent a hyperplastic response to a pre-existing arterial malformation. It is most commonly seen in women and has no malignant potential. A central scar may be seen which shows delayed enhancement.

- 14 A 52 year woman with a history of atrial fibrillation and rheumatoid arthritis presents with right-sided renal colic. On the unenhanced CT study there is diffuse low density in the liver.**

**Which of the following might account for this appearance?**

- (a) Amyloidosis
- (b) Amiodarone therapy
- (c) Haemochromatosis
- (d) Haemosiderosis
- (e) Wilson's disease

**14 (a)**

The most common cause of diffuse low attenuation is fatty infiltration; amyloidosis is another due to amyloid deposition. Amyloidosis can be a primary condition, or secondary to chronic infectious, chronic inflammatory disease (e.g. rheumatoid arthritis), or multiple myeloma. Answers (b) – (d) increase copper/iron deposition within the liver, which will lead to increased liver density on a pre-contrast CT.

- 16** A 47-year old man presents with atypical RIF pain; a CT abdomen is requested to rule out appendicitis. No cause for abdominal pain is identified. The only finding of note is an 8 mm low-attenuation lesion within the left lobe of the liver. The lesion lies inferior to the portal vein and lateral to the left hepatic vein.

**What segment of the liver is the lesion in?**

- (a) Segment I
- (b) Segment II
- (c) Segment III
- (d) Segment IV-A
- (e) Segment IV-B

**16 (c)**

The Couinaud classification divides the liver into 8 functionally independent segments, each with its own blood supply and biliary drainage. The portal vein divides the liver into superior and inferior segments. The middle hepatic vein divides the left (segments I-IV) and right lobes (segments V-VIII). The right hepatic vein divides the right lobe into anterior (V and VIII) and posterior (VI and VII) segments. The left hepatic vein divides the left lobe into medial (segments IV-A and IV-B) and lateral part (segments II and III); segment I is the caudate lobe, situated posteriorly.

- 19 A patient is referred for chemo-embolisation of a hepatocellular carcinoma in the right lobe of the liver. The initial angiogram demonstrates that the lesion is supplied from the superior mesenteric artery.**

**What proportion of patients have an arterial supply to liver from the SMA?**

- (a) 7%
- (b) 14%
- (c) 17%
- (d) 21%
- (e) 25%

**19 (e)**

14% of patients have an accessory right hepatic artery, 7% have a replaced right hepatic artery and 4% have a totally replaced hepatic artery arising from the SMA.

- 24 A 52 year old lady undergoes liver transplantation for autoimmune liver disease. 6 months later, she presents with deranged liver function and an MRCP demonstrates a non-anastamotic stricture.**

**What is the most common aetiology of non-anastamotic strictures in this group?**

- (a) Ischaemia
- (b) Rejection
- (c) Recurrent autoimmune liver disease
- (d) Biliary cast syndrome
- (e) Post-transplantation lymphoproliferative disease

**24 (a)**

Ischaemia is the underlying cause in approximately 50% of cases; the bile ducts are supplied by the hepatic artery and their blood supply is inevitably disrupted to some extent during transplantation. Evaluation of the hepatic arterial supply to the graft is crucial as thrombosis usually requires re-transplantation in the adult population.

**26 A 56 year old woman is referred for an US of the liver which shows a solitary 3 cm hypoechoic lesion. US contrast is given which demonstrates the lesion to be hyporeflexive with rim enhancement. The rim enhancement fades in the portal venous phase and the lesion becomes increasingly hyporeflexive and well-defined.**

**What is the most likely diagnosis?**

- (a) Cyst
- (b) Haemangioma
- (c) Focal nodular hyperplasia
- (d) Hepatocellular carcinoma
- (e) Metastasis

**26 (e)**

These are the characteristic features of a hypovascular metastasis. Lesions enhance in a fashion similar to that seen on CT or MRI.



- 27 A 47 year old man with multifocal hepatocellular carcinoma and chronic liver disease is referred for consideration of liver transplantation.**

**Which of the following would be considered for transplantation in the UK?**

- (a) 2 lesions measuring 5 cm or less
- (b) 2 lesions measuring 4 cm or less
- (c) 3 lesions measuring 3 cm or less
- (d) 4 lesions measuring 2 cm or less
- (e) 5 lesions measuring 2 cm or less

**27 (c)**

Transplantation is considered in patients with 1 lesion <5 cm or up to 3 lesions measuring 3 cm or less, the 'Milan Criteria'.

- 41 You are referred a patient with a history of previous left hepatectomy. What liver segments will have been resected?**

- (a) I & II
- (b) II & III
- (c) I, II & III
- (d) II, III & IV
- (e) I, II, III & IV

**41 (b)**

These segments are also referred to as the left lateral lobe. Resection of Segment IV also is termed an extended left hepatectomy. Resection of V, VI, VII and VIII is a right hepatectomy; an extended right hepatectomy includes segment IV also. The caudate lobe is usually only resected during liver transplantation.

**46 With regard to non-alcoholic steato-hepatitis (NASH), which of the following statements is not true?**

- (a) It is seen in up to 30% of the population
- (b) Diabetes mellitus is a risk factor
- (c) Up to 15% of patients progress
- (d) Is associated with hepatic fibrosis
- (e) May resolve with dietary modifications alone

**46 (a)**

Hepatic steatosis is seen in this proportion of the population; of these, 6-8% progress to NASH, where there is inflammation of the hepatocytes and abnormal liver function.

**58 A 48 year old man with diabetes mellitus and abnormal liver function undergoes an MRI of the liver. The liver parenchyma has a smooth contour and is relatively hypointense on the T1-weighted image and hypointense to muscle on the T2-weighted image.**

**What is the most likely diagnosis?**

- (a) Acute hepatitis
- (b) Fatty liver
- (c) Haemochromatosis
- (d) Autoimmune liver disease
- (e) Wilson's disease

**58 (c)**

The low signal within the liver parenchyma on T2-weighted images is due to the susceptibility artefact from iron overload. Patients with haemochromatosis deposit iron within the skin, heart, liver and pancreas. This degree of iron within the liver can be quantified using MRI.

- 59** A previously well 56 year old man presents with right upper quadrant pain and tenderness associated with nausea and vomiting. A liver US demonstrates the presence of a large cyst containing a number of smaller cysts with a honeycomb appearance.

**What is the most likely diagnosis?**

- (a) Cystadenoma
- (b) Cholangiocarcinoma
- (c) Hydatid cyst
- (d) Hepatocellular carcinoma
- (e) Caroli disease

**59 (c)**

Hydatid infection is caused by *Echinococcus multilocularis*, and may give rise to a number of appearances at US with cysts being uni- or multi-loculated, thin or thick-walled, with or without calcification. The appearance described here is referred to as daughter cysts. Cystadenoma gives rise to a large unilocular cyst or septated cyst. Caroli disease is due to duct abnormalities; hepatocellular carcinoma and cholangiocarcinoma are solid lesions.

- 60** Which of the following is not a recognised association of polycystic liver disease?

- (a) Non-Hodgkin lymphoma
- (b) Haemorrhage
- (c) Portal hypertension
- (d) Infection
- (e) Polycystic kidney disease

**60 (a)**

Polycystic liver disease is a hereditary condition that may or may not be associated with polycystic kidney disease. There is no malignant potential within the cysts but complications may arise from the sheer size of the cysts, and therapeutic interventions. Aspiration, fenestration and enucleation may provide short term relief, but some cases will require repeated therapy or transplantation.

**63 Which of the following conditions is not associated with nodular regenerative hyperplasia?**

- (a) Polycythaemia rubra vera
- (b) Rheumatoid arthritis
- (c) Cirrhosis
- (d) Systemic lupus erythematosus
- (e) Non-Hodgkin's lymphoma

**63 (c)**

NRH is diffuse nodularity of the liver produced by regenerative nodules in the absence of hepatic fibrosis. Although a rare entity, it is commonly associated with portal hypertension (50% cases).

- 32) A 64-year-old man with known sigmoid adenocarcinoma diagnosed at endoscopy undergoes staging CT. A solitary, well-defined, rounded, homogeneous, 1 cm mass of mean attenuation value identical to the spleen is seen near the splenic hilum. What is the most likely diagnosis?
- a. metastatic lymph node
  - b. wandering spleen
  - c. splenic artery aneurysm
  - d. polysplenia
  - e. accessory spleen

32) e. \*\*\*

Accessory spleen (splenunculus) is seen in 10–30% of the population and results from developmental failure of fusion of the mesodermal buds that form the spleen. They appear as small (usually <10 mm), well-defined masses with identical attenuation and enhancement characteristics as the spleen, and are most commonly located near the splenic hilum. Following splenectomy for haematological disorders, an accessory spleen may undergo hypertrophy and result in recurrence of the original disorder. Regional lymph nodes from colorectal cancer extend along the course of the main vessels supplying the segment of bowel. Wandering spleen refers to a normal spleen positioned in an abnormal location within the abdomen due to laxity of the splenic ligaments. Splenic artery aneurysms are focal dilatations of the splenic artery, which may be intra- or extrasplenic and are frequently calcified. Polysplenia is a rare congenital disorder associated with situs ambiguous, and characterized by multiple small spleens usually in the right abdomen.



- 33) A 45-year-old woman with pleuritic chest pain and breathlessness undergoes CT pulmonary angiogram for suspected acute pulmonary embolism, which demonstrates multiple irregular areas of relatively poor enhancement in the visualized portion of the spleen. What is the most likely cause?
- a. normal arterial-phase enhancement
  - b. splenic infarction
  - c. splenic clefts
  - d. splenosis
  - e. spontaneous splenic rupture

33) a. \*\*\*

A CT pulmonary angiogram is performed during pulmonary arterial phase enhancement. During arterial phase enhancement, variable rates of flow through the splenic parenchyma result in heterogeneous enhancement, which may appear as alternating bands of high and low attenuation, or give the impression of irregular, low-density mass lesions. Enhancement becomes homogeneous in the portal venous phase. Splenic infarction is the most common cause of (true) focal splenic defects, and typically appears as single or multiple, wedge-shaped, peripheral, low-attenuation defects. Clefts in the splenic

contour are common normal variants, appearing as smoothly contoured, medially located defects, and should not be mistaken for lacerations. Splenosis is the implantation of splenic tissue in ectopic sites following traumatic rupture or splenectomy, and appears as multiple, small, homogeneous, enhancing masses that may mimic peritoneal deposits. Spontaneous splenic rupture is rare, though it may be delayed following trauma or be associated with splenomegaly. Appearances may include low-density, linear, parenchymal lacerations and areas of mottled parenchymal enhancement representing contusions.

- 64) A 64-year-old man undergoes renal ultrasound scan and is incidentally noted to have a well-defined, rounded, 3 cm lesion in the spleen. It has a thin wall with curvilinear rim calcification and contains low-level internal echoes. What is the most likely diagnosis?
- a. post-traumatic (false) cyst
  - b. epidermoid cyst
  - c. echinococcal cyst
  - d. pyogenic abscess
  - e. pancreatic pseudocyst

64) a. \*\*\*\*

Approximately 80% of all splenic cysts are post-traumatic cysts (also known as false cysts or non-pancreatic pseudocysts), which represent the cystic end stage of trauma, infection or infarction. They are not true cysts, as they lack an epithelial wall. They often contain internal echoes from debris and cyst wall calcification. True cysts may be parasitic (echinococcal) or non-parasitic (epithelial). The spleen is involved in 0.9–8% of cases of echinococcal disease. Features include daughter cysts, and multiple internal dependent echogenic foci resulting in a 'snowstorm' sign. Epidermoid cysts are congenital cysts with the same appearance as post-traumatic cysts, but they are rarer, and rim calcification is less commonly seen. Pyogenic abscesses tend to appear as irregular hypoechoic areas on ultrasound scan, and hyperechoic gas bubbles may be visible. Intrasplenic pancreatic pseudocysts are seen in up to 5% of patients with pancreatitis.

- 68) On contrast-enhanced CT of the abdomen, what is the most common abnormality of the spleen seen in sarcoidosis?
- a. capsular calcification
  - b. multiple low-attenuation nodules
  - c. splenomegaly
  - d. splenic rupture
  - e. multiple cystic lesions



68) c. \*\*\*\*

Although symptoms directly referable to the spleen are unusual, autopsy studies have demonstrated the spleen to be involved in 38–77% of patients with sarcoidosis. The commonest abnormality demonstrated on imaging is splenomegaly, occurring in up to 60% of patients. Multiple hypoattenuating nodules measuring up to 3 cm may be seen distributed diffusely throughout the spleen in around 15% of cases, and may occur in the absence of splenomegaly. The lesions appear hypointense on all sequences at MRI and are best seen on T1W or early phase, gadolinium-enhanced, T2W fat-suppressed sequences. Abdominal or systemic symptoms are more frequent in patients with nodular hepatosplenic sarcoidosis. Spontaneous splenic rupture in sarcoidosis has been described but is very rare. Capsular calcification and multiple cystic lesions are not features of the disease.

41. A 32 year old woman with no significant past medical history has a CT scan as an outpatient for right iliac fossa pain. No cause for the pain is discovered on this investigation. However, a 1 cm diameter, smoothly marginated, circular, homogenous area of tissue is seen next to the splenic hilum. This area of tissue is isodense compared to normal splenic parenchyma. What is this most likely to be?
- a. Splenosis
  - b. Splenunculus
  - c. Lymphoma
  - d. Splenic hamartoma
  - e. Wandering spleen

41. b. **Splenunculus**

Splenunculus is most likely, and is often seen incidentally. It is much more common than splenosis and is more likely to occur at the splenic hilum than splenosis. A splenunculus, or accessory spleen, is present in up to 30% of people and is most often located near the splenic hilum, but can occur anywhere in the abdomen. Splenogonadal fusion is a recognised entity whereby the accessory splenic tissue is attached to the left ovary or testis. Splenosis occurs following trauma, whereby splenic tissue autotransplants elsewhere in the abdomen, and can also implant above the diaphragm if associated with diaphragm rupture. A wandering spleen denotes abnormal mobility of the spleen on long peritoneal ligaments.

58. A 73 year old female has a CT abdomen and pelvis for the investigation of anaemia and weight loss. Massive splenomegaly (30 cm) is present with no other abnormalities. Which of the following conditions is most likely to be the underlying cause?
- a. Sarcoidosis
  - b. Felty's syndrome
  - c. Chronic myeloid leukaemia → That only one that cause massive splenomegaly
  - d. Haemochromatosis
  - e. Non-Hodgkin's lymphoma

**58. c. Chronic myeloid leukaemia**

Splenomegaly is a relatively common finding in many different diseases, but massive splenomegaly always indicates underlying pathology. Although there is no unifying definition, it is often recognised to be enlargement of the spleen into the left lower quadrant of the abdomen or crossing the midline. All the options listed are causes of splenomegaly, however chronic myeloid leukaemia is the only listed cause of massive splenomegaly. Other causes of massive splenomegaly include Gaucher's disease, malaria, myelofibrosis, schistosomiasis and Leishmaniasis.

- 45 A 65-year-old recently retired labourer had an abdominal CT to investigate general malaise. This showed multiple discrete areas of low attenuation within the spleen, which were rounded with ill-defined margins and distorted the splenic contour. It was thought that these were most likely to represent metastatic disease but the primary was not visible on the scan. What is the most likely site of the underlying primary tumour?
- a Bronchogenic carcinoma
  - b Undetected colon carcinoma
  - c Renal cell carcinoma
  - d Prostate carcinoma
  - e Malignant melanoma

**45 Answer E: Malignant melanoma**

Malignant melanoma is the most common primary that metastases to the spleen. Malignant melanoma is more common in fair skinned individuals and those that spend a significant amount of time outdoors.

- 47 A 45-year-old male with a previous history of a splenectomy post trauma as a child was being assessed to determine if he had splenosis. What is the most sensitive modality?
- a Angiography
  - b Contrast-enhanced CT
  - c MRI
  - d Nuclear medicine studies
  - e Ultrasound

47 Answer D: Nuclear medicine studies

Splenosis is autotransplantation of splenic fragments post trauma and is best seen with  $^{99m}\text{Tc}$  RBC or  $^{99m}\text{Tc}$  sulphur colloid studies.

- 48 A 24-year-old HIV-positive patient presented with vague abdominal pain and fever. Ultrasound of the abdomen demonstrated hepatomegaly and multiple rounded lesions of low reflectivity within the spleen consistent with splenic microabscesses. What is the most likely causative organism?
- a *Cytomegalovirus* (CMV)
  - b Fungal
  - c *Haemophilus*
  - d *Staphylococcus aureus*
  - e *Streptococcus pneumoniae*

48 Answer B: Fungal

Microabscesses account for 26% of splenic abscesses. Immunocompromised patients are predisposed to fungal infection particularly due to *Candida*, *Aspergillus* and *Cryptococcus*.



- 49 A 62-year-old man was admitted with sepsis and abdominal pain. Contrast-enhanced abdominal CT revealed splenic enlargement and several low-attenuation lesions within the spleen. Subsequent ultrasound-guided aspiration yielded infected material. What is the commonest cause of a splenic abscess?
- a Adjacent pericolic abscess
  - b Haematogenous spread
  - c Splenic infarction
  - d Penetrating trauma
  - e Following intervention or surgery

49 Answer B: Haematogenous spread

Splenic abscesses are uncommon and are more prevalent in patients with sickle cell disease, diabetes and the immunocompromised. The causative organism is frequently fungal and includes: *Candida*, *Aspergillus* and *Cryptococcus*. Seventy-five per cent occur due to haematogenous spread of infection; the remaining 25% occur secondary to splenic infarction or penetrating trauma.

- 43 A 28-year-old female complained of right upper quadrant pain, dyspnoea and abdominal distension shortly after a normal vaginal delivery of her first child. Transabdominal ultrasound showed ascites and an enlarged (14 cm) spleen. What is the most likely diagnosis?
- a Pulmonary embolus
  - b Cirrhosis
  - c Portal vein thrombosis
  - d Gastritis
  - e Budd-Chiari syndrome

43 Answer E: Budd-Chiari syndrome

Occlusion of the hepatic veins/IVC, often due to thrombosis in hypercoagulable states such as pregnancy. Hepatosplenomegaly, with caudate hypertrophy, are early sonographic signs with non-visualisation of the hepatic veins in 75%. Symptoms also include right heart failure and pulmonary oligoemia.

- 46 A middle-aged man underwent various investigations for abdominal pain and eventually was diagnosed with a splenic angiosarcoma. What signal characteristics would be expected on MRI?
- a Diffuse/focal low signal on T1 and T2
  - b Diffuse low signal on T1, high signal T2
  - c Diffuse high signal on T1, low signal on T2
  - d Diffuse/focal high signal on T1 and T2
  - e Mixed foci of high and low signal on T1 and T2

46 Answer A: Diffuse/focal low signal on T1 and T2

Splenic angiosarcoma is rare with less than 100 reported cases. It usually presents in patients aged 50–60 years and MRI shows diffuse or focal areas of low signal on T1 and T2 due to haemorrhage, which results in iron deposition.

- 47 An ultrasound in an elderly male demonstrated multiple splenic metastases. What is the most likely origin of primary?
- a Colon
  - b Melanoma
  - c Prostate
  - d Renal cell
  - e Stomach

47 Answer B: Melanoma

Metastases account for 7% of solid splenic tumours. Melanoma accounts for 6–34%.

- 48** During an abdominal ultrasound for non-specific abdominal pain, a 52-year-old man was noted to have a focal abnormality within his spleen. A contrast-enhanced abdominal CT was then arranged which demonstrated a focal low density and minimally vascular splenic lesion and para-aortic lymphadenopathy. His serum inflammatory markers were within normal limits. What is the most likely diagnosis?
- a Abscess
  - b Aneurysm
  - c Haemangioma
  - d Lymphoma
  - e Metastasis

**48** Answer D: Lymphoma

The differential diagnosis for a focal low-density splenic lesion includes: lymphoma, metastases, haemangioma and abscess. In this case the concurrent lymphadenopathy and normal septic markers suggest lymphoma.

- 49** A male neonate with congenital heart disease was found to have multiple spleens and a diagnosis of polysplenia syndrome was proposed. From which further abnormality is he also most likely to suffer?
- a Bilateral morphological right-sided lungs
  - b Gut malrotation
  - c Hepatic fibrosis
  - d Imperforate anus
  - e Undescended testes

**49** Answer B: Gut malrotation

Polysplenia (bilateral left-sidedness) typically presents in infancy and is associated with a variety of congenital cardiac, gastrointestinal, genito-urinary and skeletal abnormalities. Malrotation is present in 80%.

- 44** A 78-year-old female presented with left upper quadrant pain and a fever. Her past medical history included multiple myocardial infarctions, subsequent coronary artery bypass surgery, non-insulin dependent diabetes and poorly controlled hypertension. Initial baseline blood tests were unremarkable except for a mild leucocytosis. An ultrasound of her abdomen demonstrated a single ill-defined wedge-shaped area of decreased reflectivity within the spleen. What is the most likely diagnosis?
- a Primary splenic malignancy
  - b Secondary splenic malignancy
  - c Splenic infarct secondary to embolic phenomenon
  - d Splenic infarct secondary to local thrombus
  - e Splenic abscess

**44** Answer C: Splenic infarct secondary to embolic phenomenon

Splenic infarction commonly presents with left upper quadrant pain and fever in the acute setting. An elevated ESR and leucocytosis are often seen. A wedge-shaped infarct will be more ill defined acutely on ultrasound secondary to oedema and inflammation. The most common cause of infarct is due to embolic phenomenon, particularly in an arteriopath.

- 45** In a normal unenhanced CT scan of the upper abdomen, the liver parenchyma measures 65 HU. What would be the expected density of the spleen?
- a 20–30 HU
  - b 40–60 HU
  - c 65 HU
  - d 70–80 HU
  - e 100–120 HU

**45** Answer B: 40–60 HU

Unenhanced CT spleen approximately 40–60 HU, and 5–10 HU less than liver.

- 46 A patient underwent a CT of the upper abdomen as part of a lung cancer staging scan. This demonstrated multiple wedge-shaped peripheral lesions of low attenuation within the spleen in both the arterial and portal venous phases. This was not thought to be due to metastases from the lung cancer. What is the commonest cause of this appearance?
- a Atheroma
  - b Bacterial endocarditis
  - c Non-Hodgkin's lymphoma
  - d Polycythaemia rubra vera
  - e Sickle cell disease

46 Answer B: Bacterial endocarditis

Splenic infarcts can be either peripheral and wedge shaped, or rounded irregularly shaped and randomly distributed. Fifty per cent of the cardiovascular-caused splenic infarcts are due to bacterial endocarditis.

- 47 A plain abdominal radiograph was performed on a patient with suspected bowel obstruction. This was unremarkable apart from multiple well-defined calcifications that were diffusely distributed throughout the region of the spleen. What is the most likely cause of this appearance?
- a Epidermoid cysts
  - b Granulomas
  - c Haematomas
  - d Phleboliths
  - e Splenic artery aneurysms

47 Answer B: Granulomas

There are numerous causes of splenic calcifications; the morphology and distribution varies according to aetiology. The commonest cause of disseminated splenic calcification is granulomatous disease, such as histoplasmosis, TB and brucellosis.



- 48 A 37-year-old Afro-Caribbean woman with suspected erythema nodosum was referred to a dermatologist. On physical examination she was noted to have a palpable spleen and an abdominal ultrasound was requested. This demonstrated moderate splenic enlargement and scattered nodular lesions throughout the liver and spleen. What is the most likely unifying diagnosis?
- a Amyloidosis
  - b Chronic myeloid leukaemia
  - c Malaria
  - d Sarcoidosis
  - e Untreated lymphoma

48 Answer D: Sarcoidosis

Erythema nodosum is the most common presentation of sarcoid (30%). Hepatobiliary manifestations of sarcoid include: hepatomegaly, splenomegaly, nodular lesions in the liver and spleen, lymphadenopathy and pancreatic mass.

A general differential diagnosis for splenomegaly includes:

- huge spleen: chronic myeloid leukaemia, myelofibrosis, malaria, Kala-azar, Gaucher's disease, lymphoma
- moderately enlarged spleen: all of the above plus storage diseases, haemolytic anaemias, portal hypertension and leukaemias
- slightly enlarged spleen: all of the above plus infections, sarcoidosis, amyloidosis, rheumatoid arthritis and systemic lupus erythematosus.

7. A 24-year-old male patient is brought into A&E following a high-speed RTA. His blood pressure was 90/60 mmHg and his heart rate was 112 on admission, but these observations respond well to intravenous fluids and the patient has remained stable since. He complains of left-sided abdominal pain. A pneumothorax is noted on CXR, with associated left-sided rib fractures. An urgent CT scan of chest and abdomen is carried out. This reveals fluid in the abdomen. A crescentic area of low attenuation is noted around the spleen. There is a further area of hypoattenuation passing 4 cm into the splenic parenchyma, adjacent to the hilum. The rest of the splenic parenchyma is of uniform attenuation. The CT also shows a flail segment of chest and an area of lung contusion at the left base. Which of the following statements with regard to the spleen is true?

- A. The appearances described represent subcapsular haematomas.
- B. The appearances described represent a haematoma and a parenchymal laceration. The presence of free fluid represents acute haemorrhage and a laparotomy is indicated.
- C. The appearances are consistent with a shattered spleen as the laceration extends to the hilum.
- D. The appearances are consistent with a subcapsular haematoma and a splenic laceration. Conservative management is appropriate with serial CT scans.
- E. Whilst the appearances are consistent with a laceration and subcapsular haematoma, radiological findings are not reliable in determining the need for a laparotomy.**

**7. E.** Whilst the appearances are consistent with a laceration and subcapsular haematoma, radiological findings are not reliable in determining the need for a laparotomy.

Splenic injuries can be graded 1–5 (American Association of Trauma Surgeons). **Grade 1** is a subcapsular haematoma that involves <25% of the splenic surface or a laceration <1cm deep. **Grade 2** is a haematoma that involves 25–50% of the surface or a laceration up to 3cm deep. **Grade 3** is a haematoma involving >50% of splenic surface or 10 cm in length or a laceration greater than 3 cm into the parenchyma. **Grade 4** is a laceration extending into the hilum that devascularizes up to 25% of the spleen. **Grade 5** is a shattered spleen, with multiple lacerations or a spleen avulsed from its vascular bed. Radiological findings do not correlate well with requirement for laparotomy in the more minor splenic injuries. Clinical assessment is of more value, with surgery only indicated in unstable patients. The value of radiology is in detecting other injuries and in quantifying the amount of the haematoma due to the risk of delayed splenic rupture in more severe injuries.

**62. A patient with a known history of malignancy undergoes a CT scan of the chest, abdomen, and pelvis for staging purposes. This examination identifies a solitary hypodense lesion in the spleen measuring 4 cm in diameter, but no other evidence of metastatic disease. A PET-CT is considered as a possible mechanism for determining whether or not this is a metastasis, but is considered not likely to be helpful. Which malignancy is the patient most likely to have?**

- A. Melanoma.
- B. Lung carcinoma.
- C. Lymphoma.
- ☒ D. Renal cell carcinoma.
- E. Colon carcinoma.

*PET is helpful in others  
RCC shows no uptake*

**62. D. Renal cell carcinoma.**

All the other tumours are more likely to be FDG avid than renal cell carcinoma.

**63. A 54-year-old man has a CT scan of renal tracts for suspected right renal colic. The right renal tract is normal, but an incidental 6-cm well-defined cyst is noted within the spleen. There is no past medical history of note. What is the most likely aetiology of the splenic cyst?**

- ☒ A. Previous trauma.
- B. Echinococcal infection.
- C. Congenital cyst.
- D. Liquefied infarct.
- E. Unilocular lymphangioma.

**63. A. Previous trauma.**

Splenic cysts are classified into two major subtypes: true cysts and false cysts (post-traumatic pseudocysts). This differentiation is based on the presence or absence of an epithelial lining.

They cannot be distinguished on imaging. On CT as both usually appear well-defined and of fluid density.

True cysts, which constitute approximately 20% of all splenic cysts and show an epithelial lining, are further divided into non-parasitic cysts and parasitic subtypes. Non-parasitic, true cysts, primarily known as epidermoid cysts, are congenitally derived from peritoneal mesothelium and represent only 2.5% of all splenic cysts. The majority of true cysts are related to parasitic infection, usually hydatid disease.

False cysts, also known as post-traumatic pseudocysts, lack an epithelial lining and are considered to represent the end stage of a previous intrasplenic hematoma. They account for up to 80% of all splenic cysts. Patients may report a history of trauma to the left upper quadrant, but up to 30% of patients do not recall any association with such an event. More rarely they may be the result of previous infarction or infection.

True cysts are more likely to have slight wall trabeculation and thin peripheral septation (up to 86%), whereas false cysts are more likely to have mural calcification (up to 50%).

Isolated splenic lymphangioma is uncommon in adults, usually being diagnosed in childhood. It usually appears as thin-walled, well-defined masses of low attenuation, without enhancement. They may have curvilinear peripheral mural calcification.

**3 A 47 year old patient is referred for an abdominal US. In the spleen, several rounded, thin-walled hypoechoic lesions are seen in a subcapsular position. CT shows the lesions have a density of 20 HU and there is no enhancement with intravenous contrast medium.**

**What is the most likely diagnosis?**

- (a) Infarction
- (b) Lymphangioma
- (c) Haemangioma
- (d) Hamartoma
- (e) Abscess

**3 (b)**

These are the typical imaging features of these asymptomatic lesions. Infarcts are usually wedge-shaped, whilst the remaining lesions usually show some enhancement.



- 17 An unenhanced CT of the liver is performed. The liver has a density of 60 HU and the spleen has a density of 50 HU.**

**How might you account for these findings?**

- (a) Normal findings
- (b) Diffuse fatty infiltration
- (c) Haemochromatosis
- (d) Wilson's disease
- (e) Budd-Chiari syndrome

**17 (a)**

The normal liver has a density of 50–70 HU. Fatty infiltration will reduce this as the atomic numbers of the elements C, H and O are low. Iron and copper deposition can raise the density, as they have high atomic numbers.

- 24 Which of the following is true of polysplenia?**

- (a) It has an 80% mortality in the first year
- (b) It is associated with total anomalous pulmonary venous drainage
- (c) It is more common in females
- (d) It is associated with right isomerism
- (e) It is associated with annular pancreas

**24 (c)**

The remaining features are seen in asplenia, which is more commonly seen in males. Polysplenia has a mortality of 50–60% and is associated with partial abnormal pulmonary venous return, left isomerism and a semi-annular pancreas.



- 25 An 18 year old man undergoes an abdominal US and is found to have splenomegaly with multiple focal lesions.**

**Which of the following diagnoses is least likely to give these appearances?**

- (a) Sarcoidosis
- (b) Lymphoma
- (c) Portal hypertension
- (d) Sickle cell disease
- (e) Amyloidosis

**25 (d)**

Sickle cell disease results in chronic sequestration with a small, occasionally calcified, spleen. The remaining diagnoses can cause splenomegaly with or without focal lesions.

- 75 A 47 year old man undergoes a CT of the abdomen and pelvis for suspected renal colic. Other than a previous road traffic accident, the patient has no medical history. Incidentally, the radiologist finds a number of lesions throughout the abdominal cavity of uncertain aetiology. The patient subsequently undergoes a  $^{99m}\text{Tc}$ -sulphur colloid study and the lesions show tracer uptake.**

**What is the most likely diagnosis?**

- (a) Peritoneal metastases
- (b) Tuberculosis
- (c) Sarcoidosis
- (d) Splenosis
- (e) Mesothelioma

**75 (d)**

Splenosis represents the heterotopic autotransplantation of splenic tissue that usually follows traumatic rupture of the spleen. The diagnosis may also be made with  $^{99m}\text{Tc}$ -labelled heat denatured erythrocytes or MRI following administration of iron-oxide particles.

10) A 65-year-old woman undergoes CT of the abdomen. An incidental finding of a well-defined 5 cm mass in the head of the pancreas is noted. It has a mean attenuation value of 5 HU, and contains multiple tiny cysts with a central nidus of calcification. There is no pancreatic duct dilatation. What is the most likely diagnosis?

- a. mucinous cystadenoma
- b. main duct intraductal papillary mucinous tumour
- c. serous cystadenoma
- d. pancreatic pseudocyst
- e. pancreatic insulinoma

10) c. \*\*\*\*

*innumerable small cysts (1-70) mm*

**Serous cystadenomas** are benign neoplasia of the pancreas most commonly seen in older women and are frequently asymptomatic. Typical appearances are of a cystic lesion measuring up to ~~20~~ cm in size, containing innumerable small cysts, though these may be difficult to discriminate, giving the appearance of a solid mass. They may occur in any part of the pancreas but are slightly more common in the pancreatic head and neck. **Characteristic features include a central stellate scar containing dystrophic calcification.** **Mucinous cystadenomas** usually occur in the pancreatic tail (90%) and, when multilocular, contain larger cysts of >2 cm in diameter. **Pancreatic pseudocysts** are usually unilocular and occur following a history of pancreatitis. **Intraductal papillary mucinous tumours of the main duct** are typically associated with dilatation of the main pancreatic duct. **Insulinomas** are usually small (<2 cm) solid tumours that produce symptoms early due to recurrent hypoglycaemia.

*size 5-10 cm*

15) A 50-year-old woman presents with recurrent episodes of hypoglycaemia. Biochemistry confirms endogenous insulin hypersecretion, and she undergoes multiphasic CT of the abdomen. Which of the following is the most likely finding in the pancreas?

- a. 1.5 cm arterially enhancing, solid mass in the head
- b. 5 cm arterially enhancing, cystic mass in the tail
- c. 1.5 cm arterially enhancing, cystic mass in the body
- d. 1.5 cm non-enhancing, solid mass in the tail
- e. 5 cm non-enhancing, cystic mass in the body

15) a. \*\*\*\*

**Insulinomas** are rare tumours of the islet cells of the pancreas, which present at an early stage with hypoglycaemic episodes. Diagnosis is made biochemically, by demonstrating fasting hyperinsulinaemia, and the main purpose of imaging is to detect and localize accurately the tumours, which tend to be small ( $<2$  cm) at presentation. Tumours may occur anywhere in the pancreas, with 2–5% in an ectopic location. CT is considered the first-line investigation, but newer techniques such as MR and functional imaging are being increasingly used. On CT, insulinomas

are typically solid and highly vascular, and are best visualized on arterial-phase imaging, when they demonstrate marked enhancement.

17) A 64-year-old woman presents to the dermatologist with erythematous maculopapular lesions on her legs, buttocks and face, and is diagnosed with necrolytic migratory erythema. Which initial imaging investigation is most appropriate?

- a. no imaging
- b. mammography
- c. CT of the brain
- d. chest radiograph
- e. CT of the abdomen

associated  
with glucagonoma  
of pancreas

17) e. \*\*\*

Necrolytic migratory erythema is a rare dermatological condition with a strong association with glucagonoma, an islet-cell tumour of the pancreas derived from alpha cells. Over 70% of patients with glucagonoma demonstrate the condition, and they may also complain of weight loss, diarrhoea and diabetes. The association is considered strong enough to warrant thorough investigation for pancreatic malignancy. Glucagonomas typically occur in the pancreatic body or tail, and are large (2.5–25 cm) hypervascular tumours with solid and necrotic components. They have a high rate of malignant transformation, and around 50% of patients have liver metastases at the time of diagnosis.

67) A 58-year-old man with recurrent episodes of upper abdominal pain undergoes MRCP, which demonstrates pancreatic atrophy and marked dilatation of the main pancreatic duct, which contains high T2-signal material. A low T2-signal nodular filling defect is also identified within the dilated duct. ERCP demonstrates thick mucus protruding from a bulging papilla. What is the most likely diagnosis?

- a. intraductal papillary mucinous tumour
- b. chronic pancreatitis
- c. mucinous cystadenoma
- d. pancreatic pseudocyst
- e. acute pancreatitis



67) a. \*\*\*

Intraductal papillary mucinous tumour (IPMT) of the pancreas is characterized by a mucin-producing tumour with dilatation of the main or branch ducts of the pancreas due to copious secretions. They may arise in the main duct or branch duct. Main duct tumours typically cause dilatation of all or part of the duct, which is filled with mucinous secretions, appearing hyperintense on T2W images. A T2-hypointense intraductal filling defect may be identified, which may represent the tumour or concretions of mucin. Chronic pancreatitis may result in parenchymal atrophy and duct dilatation, with intraductal filling defects due to calculi or debris, but a bulging papilla at ERCP makes IPMT more likely. The branch duct type usually consists of conglomerated communicating cysts or a unilocular cyst in the uncinate process; these appearances may be mimicked by mucinous cystadenoma and pancreatic pseudocyst.

8. A 48 year old woman with upper abdominal pain is found to have a 4 cm hypervascular lesion in the head of the pancreas on contrast-enhanced CT. She subsequently has an MR scan; the lesion is of low intensity on fat-saturated T1-weighted and high intensity on T2-weighted imaging. Which of the following is the most likely diagnosis?
- a. Pancreatic adenocarcinoma
  - b. Gastrinoma
  - c. Insulinoma
  - d. Macrocytic adenoma
  - e. Pancreatic pseudocyst

8. b. Gastrinoma

Pancreatic adenocarcinoma is a hypovascular lesion. Macrocytic adenoma is also hypovascular, and is only rarely found in the head of the pancreas, with a predilection for the tail. The differential therefore lies between insulinoma and gastrinoma. Although both CT and MR imaging characteristics are similar, the majority of insulinomas are less than 1 cm in size, whereas gastrinomas tend to be larger at presentation with an average size of approximately 3 cm. Gastrinoma is associated with peptic ulceration and Zollinger-Ellison syndrome.

11. A 56 year old woman is diagnosed with pancreatic adenocarcinoma. Which one of the following features on the pancreatic MR contraindicates curative surgery?
- a. Splenic vein invasion
  - b. Tumour size of 2 cm
  - c. Portal vein invasion
  - d. Hepatic artery invasion
  - e. Invasion of the second part of the duodenum

**11. d. Hepatic artery invasion**

The only widely recognised absolute contraindication to curative surgical resection of the options listed is invasion of the hepatic artery. Invasion of the splenic and portal veins are relative contraindications as long as the veins are not completely occluded. Invasion of the second part of the duodenum is not a contraindication as it is resected at surgery. Other features that make the tumour unsuitable for curative resection are distant metastases, ascites, distant organ invasion, SMA/coeliac/aortic invasion and involved lymph nodes outside the boundaries of the resection.

18. A 72 year old woman has a pancreatic MR to investigate recurrent episodes of pancreatitis. There is generalised pancreatic atrophy with dilatation of the main pancreatic duct and branch ducts, particularly in the tail. No focal lesion or intraductal calculi are present. Which one of the following diagnoses is most likely?
- a. Microcystic cystadenoma
  - b. Intraductal papillary mucinous tumour of the pancreas
  - c. Cystic metastases
  - d. Cystic islet cell tumour
  - e. Pancreatic lipomatosis

**18. b. Intraductal papillary mucinous tumour of the pancreas**

Intraductal papillary mucinous tumour (IPMT) of the pancreas is a rare tumour. It tends to present in the elderly population and can be a cause of recurrent pancreatitis. Two recognised types include main duct IPMT, in which the main pancreatic duct is dilated, and branch duct IPMT, in which the main duct is usually uninvolved. It is a risk factor for mucinous carcinoma of the pancreas. Pancreatic atrophy is often present. Imaging characteristics are often similar to those seen in chronic pancreatitis, although calcification is not a feature of IPMT.

21. A 58 year old male has a CT staging scan following a diagnosis of adenocarcinoma of the body of the pancreas. The tumour is 3 cm in size and extends beyond the boundaries of the pancreas but does not invade any vessels or adjacent organs. Two 1 cm lymph nodes lie adjacent to the tumour. No other nodes, or metastatic disease in the chest, abdomen or pelvis, are identified. The tumour is best staged as which one of the following?

- a. T1N0M0
- b. T1N1M0
- c. T2N0M0
- d. T3N0M0
- e. T3N1M0

$T1 \Rightarrow < 2$   
 $T2 \Rightarrow > 2$  } confined to pancreas  
 $T3 \Rightarrow$  beyond pancreatic boundaries  
 $T4 \Rightarrow$  Invasion of vessels or other structures

21. e. T3N1M0

T1 tumour is disease confined to the pancreas and less than 2 cm in diameter. T2 tumour is also confined to the pancreas but greater than 2 cm in diameter. As the tumour extends beyond the boundary of the pancreas, it is at least T3. Invasion of the coeliac or superior mesenteric arteries would make this a T4 tumour, but as these features are not present it is T3. The presence of regional nodes make it N1 rather than N0 (no nodes involved), and there is no metastatic disease so it is M0. Therefore the correct radiological stage is T3N1M0.

38. A 68 year old female has a pancreatic MR for characterisation of an isolated lesion within the pancreas seen initially on CT performed for unexplained weight loss. The lesion is 3 cm in diameter, isointense on T1, isointense on T2 STIR and hypointense to pancreatic parenchyma during the arterial phase of gadolinium enhancement. It remains hypointense on the venous and delayed phases of contrast enhancement. Which one of the following is the most likely diagnosis?
- a. Ductal adenocarcinoma
  - b. Insulinoma
  - c. Simple pancreatic cyst
  - d. Gastrinoma
  - e. Glucagonoma

**38. a. Ductal adenocarcinoma**

Insulinoma tends to be hyperintense on contrast-enhanced images. Gastrinoma is usually hyperintense on STIR imaging and on contrast-enhanced sequences. In a series of 25 patients, an article by Chandarana *et al.* showed that pancreatic adenocarcinomas were either iso- or hypointense on T1-weighted imaging and iso- or hyperintense on T2 or STIR. All adenocarcinomas were hypointense to pancreatic parenchyma during the arterial phase of gadolinium enhancement on MR, 80% remained hypointense in the venous phase of enhancement and 68% remained hypointense in the delayed phase.

(Ref: Chandarana H *et al.* Signal characteristic and enhancement patterns of pancreatic adenocarcinoma: evaluation with dynamic gadolinium enhanced MRI. *Clinical Radiology* 2007; 62: 876–883)

42. A 58 year old male with unexplained elevated alkaline phosphatase has an MRCP and the 'double-duct' sign is observed. Which one of the following diagnoses is most likely to cause this finding?

- a. Acute pancreatitis
- b. Annular pancreas
- c. Pancreas divisum
- d. Periapillary tumour
- e. Duodenal perforation

**42. d. Periapillary tumour**

The 'double-duct' sign is dilatation of the main pancreatic duct and the common bile duct as seen at ERCP and MRCP, and less commonly with CT and ultrasound. It occurs due to an obstructing lesion at the ampulla, most commonly a carcinoma of the head of the pancreas (in up to 77% of cases) or a carcinoma of the ampulla of Vater (in up to 52% of cases). The sign may be absent if there is an accessory pancreatic duct or when the main pancreatic duct drains into the minor papilla.

- 62 A 39-year-old male alcoholic represented to the Emergency Department feeling generally unwell three weeks after an initial diagnosis of acute pancreatitis. He self-discharged himself from hospital after 10 days of treatment. His original CT at diagnosis showed inflammation of the whole gland and a repeat CT on his representation showed a well-demarcated 4 cm × 3 cm fluid collection directly anterior to the body of the pancreas which contained a small bleb of gas. What is the most likely diagnosis?
- a Acute pseudocyst
  - b Enteric fistula
  - c Gland necrosis
  - d Pancreatic abscess
  - e Pancreatic phlegmon

62 Answer D: Pancreatic abscess

Pancreatic abscesses usually occur two to four weeks after onset of severe acute pancreatitis. It is seen as a fluid collection close to the pancreas itself, the most common organism is *E. coli* and 30–50% contain gas. Patients are usually generally unwell and have symptoms and signs of sepsis with raised inflammatory markers. Pseudocysts take over four weeks to develop and rarely contain gas.

- 63 A patient with Von Hippel-Lindau syndrome was being investigated for renal symptoms and an incidental finding in the pancreas was made on CT. A 5-cm lobulated mass with the appearance of a 'bunch of grapes' was seen in the neck of the gland. There was a prominent central stellate scar within this lesion and distal dilatation of the pancreatic duct. What is the most likely diagnosis?
- a Acinar cell carcinoma
  - b Intraductal papillary mucinous tumour
  - c Papillary neoplasm of the pancreas
  - d Pancreatic ductal adenocarcinoma
  - e Serous cystadenoma of the pancreas



**63** Answer E: Serous cystadenoma of the pancreas

A serous cystadenoma of the pancreas is a benign lobulated neoplasm composed of innumerable small cysts 1–20 mm. The mass is usually lobulated with a mean size of 5 cm. Any part of the pancreas can be affected but it has slight predominance for the head and neck. The pancreatic duct can be displaced, encased or obstructed. A prominent central stellate scar is characteristic and there is a known association with Von Hippel-Lindau syndrome.

**64** A two-week-old baby with Down syndrome was admitted under the Paediatric team with persistent vomiting. A plain abdominal radiograph demonstrated a double bubble. An ultrasound showed proximal duodenal dilatation and concentric narrowing of the lumen at the second part of the duodenum with a bulky pancreatic head. What diagnosis best fits with these features?

- a Annular pancreas
- b Duodenal atresia
- c Duodenal stenosis
- d Malrotation
- e Pyloric stenosis

**64** Answer A: Annular pancreas

Annular pancreas is a relatively common congenital anomaly wherein a ring of normal pancreatic tissue encircles the duodenum secondary to the abnormal migration of the ventral pancreas. It is associated with other congenital abnormalities in 75%; including Down syndrome. In a neonate it usually presents with duodenal obstruction and the obstruction is at D2 in 85% of cases.

**65** CT is more sensitive than MRI for the detection of calcifications associated with chronic pancreatitis but MRI is a useful tool in assessing duct and parenchymal abnormalities in cases of chronic pancreatitis. Which abnormality is most likely to lead to a false negative on MRI?

- a Demonstrating dilated duct upstream from an obstruction
- b Demonstrating gland atrophy
- c Demonstrating intraductal stones
- d Evaluating duct strictures
- e Demonstrating intraductal stones not surrounded by fluid

**65** Answer E: Demonstrating intraductal stones not surrounded by fluid  
Visualising intraductal stones not surrounded by fluid can be difficult with MRI as there is no fluid contrast to outline the filling defect.

- 66** A pancreatic transplant patient had an ultrasound three weeks after their transplant procedure. It was difficult to delineate the margins of the gland and there was acoustic inhomogeneity and a dilated pancreatic duct. What is the correct interpretation of these features?
- a Acute rejection
  - b Graft vessel thrombosis
  - c Pancreatic abscess
  - d Pancreatitis
  - e Normal post-procedural appearances

**66** Answer A: Acute rejection

These are classic features of acute rejection. Clinically, the patient may have focal tenderness over the transplant.

- 68** A 23-year-old man with cystic fibrosis underwent a thoracic CT to assess his pulmonary disease. The upper abdomen was included and the pancreas was noted to appear abnormal. What is the most likely pancreatic abnormality?
- a Macrocystic change
  - b 'String-of-pearls' pancreatic duct
  - c Stranding of the peripancreatic fat
  - d Pancreas divisum
  - e Diffuse pancreatic atrophy

**68** Answer E: Diffuse pancreatic atrophy

- 69** A 58-year-old man presented with upper abdominal pain, haematemesis and diarrhoea. He had been treated with a proton pump inhibitor for epigastric pain for a year with little effect. Oesophagogastroduodenoscopy (OGD) revealed multiple erosions but no varices and an ultrasound showed a hypoechoic mass in the body of the pancreas. What is the most likely cause of the pancreatic abnormality?
- a Adenocarcinoma
  - b Gastrinoma
  - c Metastasis
  - d Pseudocyst
  - e VIPoma

**69** Answer B: Gastrinoma

Gastrinoma associated with peptic ulceration (Zollinger-Ellison syndrome) is the second most common functioning islet cell tumour. VIPoma is rare and not associated with peptic ulceration. Other functioning islet cell tumours include: insulinoma (commonest functional tumour), somatostatinoma and glucagonoma.

- 62** A 46-year-old male presented with a one-year history of vague epigastric pain. He had a history of ischaemic heart disease and hypercholesterolaemia. On examination there was mild hepatomegaly. Inflammatory markers, amylase and liver function tests were within normal limits. An abdominal ultrasound showed multiple hyperechoic focal deposits in the liver but obscuration of central structures by bowel gas. A CT was performed which showed two small (1-cm) lesions within the body of the pancreas that enhanced avidly in arterial phase. The liver lesions were also hypervascular. What is the most likely diagnosis?
- a Hepatocellular carcinoma
  - b Lymphoma
  - c Pancreatic acinar cell carcinoma
  - d Pancreatic ductal adenocarcinoma
  - e Pancreatic islet cell tumour

62 Answer E: Pancreatic islet cell tumour

Pancreatic islet cell tumours are often small (<2 cm) and multiple and can often be difficult to detect. They are usually iso-attenuating on unenhanced CT but show avid enhancement in arterial phase. Metastases to the liver occur in 60–90% of cases with or without lymph node involvement and are often hypervascular. The average time from onset of symptoms to diagnosis is 2.7 years.

63 A patient who was spiking temperatures on their fifth post-operative day underwent an abdominal CT. This showed reordered anatomy with a gastrojejunostomy, choledochojejunostomy and pancreaticojejunostomy. There was a small amount of free fluid and free air and more marked pneumobilia. What surgical procedure has been performed?

- a Roux-en-Y choledochojejunostomy
- b Roux-en-Y with post-operative complications
- c Roux-en-Y normal with normal post-operative appearances
- d Whipple's procedure with post-operative complications
- e Whipple's procedure with normal post-operative appearances

63 Answer E: Whipple's procedure with normal post-operative appearances

A standard Whipple's procedure is a pancreaticoduodenectomy. There are three main anastomoses: a gastrojejunostomy, a choledochojejunostomy and a pancreaticojejunostomy.

- 64 A 16-year-old boy was involved in a road traffic accident and a multi-trauma CT was performed. He had a history of several previous admissions for acute abdominal pain that had remained undiagnosed and his father had died aged 36 of pancreatic carcinoma. The CT showed a sterna fracture, lung contusions and a femoral fracture. Additionally, there were several large spherical calcifications within the pancreas and a 4-cm pseudocyst with relative preservation of the gland volume. He made a good recovery from his acute injuries but follow-up was considered for his pancreatic findings. What is the most likely diagnosis?
- a Cystic fibrosis
  - b Hereditary pancreatitis
  - c Pancreas divisum
  - d Post-mumps pancreatitis
  - e Trauma

64 Answer B: Hereditary pancreatitis

Hereditary pancreatitis is inherited in an autosomal dominant fashion. It is the most common cause of large spherical pancreatic calcifications in childhood and causes repeat episodes of pancreatitis. Twenty to forty per cent develop pancreatic carcinoma and pseudocyst formation is seen in 50%.

- 65 A patient on the ITU was recovering from multi-organ failure after a severe episode of acute pancreatitis when his haemoglobin dropped by 3 g/dL over two days. Intra-abdominal haemorrhage was suspected and CT angiography demonstrated a contrast blush adjacent to an apparently aneurysmal vessel very near the pancreas itself. Which vessel is most likely to be involved?
- a Gastroduodenal artery
  - b Inferior pancreaticoduodenal artery
  - c Pancreatic arcade arteries
  - d Splenic artery
  - e Superior pancreaticoduodenal artery



**65 Answer D: Splenic artery**

Post-inflammatory pseudoaneurysms can rupture into pre-existing pseudocysts and are caused by digestion of the arterial wall by released enzymes. This occurs in up to 10% of patients with severe pancreatitis. The splenic artery is the most common site and there is significant (approximately 35%) mortality if they rupture.

- 66** A 44-year-old obese lady was admitted with an episode of acute pancreatitis. Blood tests showed abnormal liver function and a leucocytosis. Her renal function was normal and no complication was clinically evident. Which investigation is most appropriate in this situation?
- a Contrast-enhanced CT abdomen and pelvis in 7–10 days
  - b Immediate contrast enhanced CT abdomen and pelvis
  - c Immediate contrast-enhanced CT chest, abdomen and pelvis
  - d No imaging required at present
  - e Ultrasound of the abdomen

**66 Answer E: Ultrasound of the abdomen**

In an overweight middle-aged female the most common cause of acute pancreatitis is gallstone disease. This is even more likely in the context of abnormal liver function tests. A gallstone-causing obstruction in the common bile duct should be excluded with ultrasound as this would probably require intervention. CT is mainly indicated in the context of assessment of complications.

- 67** A young boy presented after hitting the handlebars of his push bike. Imaging demonstrated pancreatic parenchymal damage that did not involve the main pancreatic duct. What grade of injury has he suffered?
- a Grade I injury
  - b Grade II injury
  - c Grade III injury
  - d Grade IV injury
  - e Grade V injury

67 Answer B: Grade II injury

Grade I: Minor contusion/haematoma, capsule and major duct intact

Grade II: Parenchymal injury without major duct injury

Grade III: Major ductal injury

Grade IV: Severe crush injury

68 During abdominal ultrasound a patient was noted to have an echogenic pancreas with areas of hypoechogenicity. A contrast-enhanced CT scan was subsequently performed which showed multiple pancreatic cysts. There was no lymphadenopathy. What further feature would make a mucinous cystic neoplasm more likely?

a Cysts with near fluid density

b Calcification

c Hypovascularity

d Cysts of 20 mm in size

e Patient in their eighth decade

68 Answer C: Hypovascularity

Features	Serous microcystic adenoma (benign)	Mucinous cystic neoplasm (malignant potential)
Number of cysts	>6	<6
Size of individual cysts	<20 mm	>20 mm
Calcification	40%: amorphous, starbursts	20%: rim calcification
Enhancement	Hypervascular	Hypovascular
Cyst content (aspiration)	Glycogen	Mucin
Other features	Central scar (15%)	Peripheral enhancement Spread: local, LN, liver
Demographics	Older patients (>60 years)	Younger patients (40–60 years)
Location	70% in head of pancreas	95% in body or tail of pancreas

- 69 An otherwise fit 54-year-old man presented with non-specific abdominal pain and weight loss. An ultrasound and subsequent CT with biopsy confirmed a diagnosis of pancreatic adenocarcinoma. A resection was planned and the CT was reviewed. Which of the following features is most compatible with a resectable tumour?
- a Dilatation of pancreatic duct
  - b Direct tumour extension of tumour into left hepatic lobe
  - c Encasement of the superior mesenteric artery
  - d Thickening of Gerota's fascia
  - e 2-cm regional lymph node

69 Answer A: Dilatation of pancreatic duct

Only 8–15% of pancreatic adenocarcinomas are resectable at the time of presentation. Resectable tumours are typically isolated pancreatic masses with or without dilatation of the pancreatic or biliary ducts. Features of irresectable tumours include: extension of tumour beyond the margins of the pancreas, tumour invasion of adjacent organs, enlarged regional lymph nodes and encasement of peripancreatic arteries and veins.

- 62 A 38-year-old male with a history of alcohol and drug abuse attended the Emergency Department with severe abdominal pain. His amylase was 5105 IU/L and a diagnosis of pancreatitis was made. The patient was resuscitated and transferred to the surgical ward where, after four days, he became more unwell. A CT was then performed which showed gland oedema, inflammatory changes in the surrounding retroperitoneal fat and hyperdense areas (50–70 HU) within the gland. What is the most likely diagnosis?
- a Haemorrhagic pancreatitis
  - b Pancreatic calcification
  - c Pancreatic necrosis
  - d Phlegmonous pancreatitis
  - e Suppurative pancreatitis

62 Answer A: Haemorrhagic pancreatitis

The hyperdense areas in the gland represent acute haemorrhage. All the other options, except calcification, produce areas of low attenuation and calcification would be greater than 50–70 HU.

- 64 An obese 40-year-old male who had been diagnosed with MEN type 1 via genetic screening underwent an abdominal MRI. Two lesions measuring 2.5 and 2 cm were identified in the pancreas. They were hypointense on T1- and hyperintense on T2-weighted images and there was ring enhancement after gadolinium administration. What is the most likely pancreatic pathology?
- a Glucagonoma
  - b Gastrinoma
  - c Insulinoma
  - d Non-functioning islet cell tumour
  - e VIPoma

64 Answer C: Insulinoma

MEN I syndrome is strongly associated with pancreatic islet cell tumours. Insulinomas are more likely to be multiple in MEN I and are usually hypointense on T1 and hyperintense on T2. Tumours over 2 cm show ring enhancement.

- 65 An eight-year-old boy was admitted after falling onto the handle bars of his bike and then onto the road. In addition to significant musculoskeletal injuries he complained of abdominal pain and on examination had a rigid abdomen with minimal bowel sounds. An ultrasound of the abdomen showed a small amount of intra-abdominal free fluid and as he was becoming more unwell an urgent CT was performed. This showed oedema in the peri-pancreatic fat and irregularity of the pancreatic contour. A discrete ill-defined area of low attenuation was seen in the region of the junction of the body and tail and there was bilateral thickening of the para-renal fascia. There was no appreciable loss of gland volume and pancreatic duct was normal. What is the most likely conclusion on the basis of these imaging findings?

- a Major ductal injury
- b Major vascular injury
- c Pancreatic contusion
- d Parenchymal injury with haemorrhage without major duct disruption
- e Post-traumatic pancreatitis

**65** Answer C: Pancreatic contusion

The area of low attenuation with the gland is consistent with a parenchymal contusion. If haemorrhage was present this would probably be of increased attenuation.

- 66** A patient presented with severe epigastric pain and acute severe pancreatitis was diagnosed. After resuscitation, what is the most useful first-line investigation in the first 24 hours?
- a Triple-phase CT
  - b Dual-phase CT
  - c Plain abdominal radiograph
  - d Ultrasound abdomen
  - e MRI pancreas

**66** Answer D: Ultrasound abdomen

- 67** A patient with pancreatitis underwent a CT scan. In addition to the expected CT findings of acute pancreatitis there was extensive pancreatic calcification and bilateral renal calculi and renal calcification. What underlying diagnosis does this suggest?
- a Alcoholic pancreatitis
  - b Hyperparathyroidism
  - c Kwashiorkor
  - d Pancreatic carcinoma
  - e Sarcoid

**67** Answer B: Hyperparathyroidism

Pancreatitis complicates 10% of hyperparathyroidism. The pattern of pancreatic calcification is indistinguishable from alcoholic pancreatitis, but the presence of renal tract calcification is highly suggestive of hyperparathyroidism.



- 68 A 70-year-old man gave a history of recurrent episodes of abdominal pain and weight loss. Ultrasound of the upper abdomen showed a non-specific abnormality for the pancreas and a CT was performed that demonstrated focal enlargement of the pancreatic head. The pancreas contained numerous irregular ductal calcifications and there was duct dilatation. There was no cystic change. What are these features most likely to represent?
- a Chronic pancreatitis
  - b Cystic fibrosis
  - c Mucinous pancreatic neoplasm
  - d Pancreatic carcinoma
  - e Pancreatic islet cell tumour

68 Answer A: Chronic pancreatitis

In chronic pancreatitis, repeated episodes of mild or subclinical pancreatitis lead to irreversible destruction of the parenchyma. The gland is often small and atrophic, but focal enlargement is present in 40%. Parenchymal calcification, fatty replacement and fibrosis are also features.

3. A patient with a history of alcohol abuse presents to A&E with epigastric pain. His haemoglobin is 8 g/dl on admission. An oesophago-gastro-duodenoscopy (OGD) and ultrasound of abdomen are requested. The ultrasound of abdomen shows multiple hyperechoic lesions in the liver. There is no evidence of gallstones. Prior to the OGD the patient becomes acutely unwell and a CT scan is requested. This shows evidence of air and fluid in the subhepatic space. It also reveals a focal enhancing lesion causing prominence of the head of the pancreas. What is the most likely diagnosis?
- A. Pancreatitis with associated peripancreatic abscess.
  - B. Pancreatic carcinoma and liver metastases.
  - C. Pancreatitis and peptic ulcer perforation in an alcoholic patient.
  - ✓ D. Islet cell tumour with liver metastases.
  - E. Cholangiocarcinoma with liver metastases.

**3. D. Islet cell tumour with liver metastases.**

Whilst this tumour is rare, the CT findings indicate a focal mass lesion in the head of the pancreas. Hyperechoic metastases in the liver are suggestive of islet cell tumour, rather than pancreatic carcinoma metastases, even though pancreatic carcinoma is more common. The islet cell tumour could be a gastrinoma, which is most commonly found in the head of the pancreas and is malignant in 60%. It is also associated with peptic ulcer disease and the finding of air and fluid in the subhepatic space suggests a perforated duodenal ulcer.

**5. A 45-year-old male patient presents to A&E with an 8-hour history of epigastric pain. There is no history of alcohol intake. On examination he is tender in the epigastrium. The initial blood tests reveal that his amylase is 1024. His WCC is slightly elevated at 15. His glucose, calcium, PaO<sub>2</sub>, liver function tests (LFTs), lactate dehydrogenase (LDH) and serum electrolytes are all normal. Following an erect CXR, what is the next most appropriate radiological investigation?**

- A. Urgent CT scan to assess the pancreas.
- B. CT within 24 hours.
- C. Ultrasound scan within 24 hours.
- D. Endoscopic retrograde cholangiopancreatography (ERCP) to look for ductal calculi.
- E. MRCP on this admission to assess for ductal stones.

**5. C. Ultrasound scan within 24 hours.**

CT is only indicated as an investigation in cases of pancreatitis with severe prognostic indicators. This patient's Ranson score is 1, which indicates a mild episode of pancreatitis and therefore CT is not indicated. ERCP was formerly contraindicated in pancreatitis, but is now recognized as a treatment for obstructing stones in the ampulla that are causing the pancreatitis. Ultimately further investigations can be directed based on the ultrasound findings.

**15. A patient is being worked up for a pancreatic neoplasm to assess potential resectability. Which one of the following does not rule out surgery?**

- A. Extension of the tumour beyond the margins of the pancreas into duodenum.
- B. Tumour involvement of adjacent organs.
- C. Enlarged peripancreatic lymph nodes (>15 mm).
- D. Encasement or obstruction of superior mesenteric vessels.
- E. Peritoneal carcinomatosis.

**15. C.** Enlarged peripancreatic lymph nodes (>15mm).

Enlarged regional nodes are a sign of unresectability, but nodes adjacent to the pancreas are resected as part of Whipple's procedure. The other factors all indicate that a pancreatic lesion is unresectable. Other features of unresectable pancreatic carcinoma are liver metastases. Only 10–15% of pancreatic neoplasms are resectable at presentation.

**24. A** 50-year-old female patient is referred for an outpatient CT after an ultrasound carried out to look for gallstones revealed a cystic lesion within the pancreas. The CT shows a number of large cysts of over 2 cm in diameter, containing fluid measuring 3 HU in the head and body of the pancreas. These cysts have thin enhancing walls. The pancreatic duct is not significantly distended. On further questioning the patient denies a history of previous pancreatitis. An MRI does not extend the diagnostic process. An FNA reveals fluid low in amylase, but with high carcino-embryonic antigen (CEA) content. What is the most likely diagnosis?

- A. Pancreatic pseudocyst.
- B. Mucinous cystic neoplasm.
- C. Microcystic pancreatic tumour.
- D. Intraductal papillary mucinous tumour (main duct type).
- E. Lymphangioma.

**24. B.** Mucinous cystic neoplasm.

Mucin is detected in FNA fluid in these lesions. Pseudocysts are uncommon without a history of pancreatitis and the aspirated fluid is high in amylase. The cysts in microcystic lesions are usually smaller than 1cm, except in the oligocystic variant. They are also known as serous cystadenomas. Intraductal papillary mucinous tumours cause dilatation of the main pancreatic duct, side branch ducts or both. FNA, either percutaneous or via endoscopic ultrasound, has been described as a low-risk procedure for differentiating pancreatic cystic lesions.



**32. A 35-year-old female undergoes an MRI of abdomen that shows multiple cystic lesions in the pancreas. Each lesion consists of a cluster of small cysts with central scar. Multiple cysts and solid lesions are also noted in both kidneys. What further investigation/s would you recommend?**

*Von-Hippel*

- A. Ophthalmology referral.
- B. MRI of the brain.
- C. MRI of the spine.
- D. Molecular genetic testing and genetic counselling.
- ✓ E. All of the above.

**32. E. All of the above.**

All the findings are manifestations of von Hippel–Lindau (VHL) disease. VHL is a rare, inherited, multisystem disorder characterized by the development of multiple benign and malignant neoplasms. It is an autosomal dominant disorder caused by inactivation of a tumour suppressor gene located on chromosome 3p25.5.

The clinical manifestations are broad and include central nervous system (CNS) and retinal haemangioblastomas, renal cysts and tumours, pancreatic cysts and tumours, pheochromocytomas, endolymphatic sac tumours, and epididymal cystadenomas.

The diagnostic criteria for VHL include: (i) >1 CNS haemangioblastoma, (ii) one CNS haemangioblastoma + visceral manifestations of VHL, and (iii) any manifestation + known family history of VHL. The most common causes of death in VHL are renal cell carcinoma and neurologic complications of cerebellar haemangioblastomas. Genetic counselling and screening are important for early detection and treatment of VHL lesions.

**41. A 63-year-old male patient is admitted with acute pancreatitis. During his admission survey he is noted to have a Ranson score of 7 and he is transferred to the ICU. A CT scan is carried out prior to ICU admission and shows a homogeneously enhancing enlarged pancreas with a fluid collection in the tail. There are gallstones in the gallbladder, with a dilated duct. A further CT is carried out on day 3 and this shows two further fluid collections in the tail of the pancreas, with an area of poorly enhancing pancreas that involves over half of the gland. There is no evidence of abscess. Which of the following options is most useful in detecting the severity of this patient's pancreatitis?**

- A. Ranson score to indicate severity of pancreatitis. CT is of value in detecting complications.
- B. CT within 24 hours to show presence of gland swelling and/or necrosis.
- C. CT scan within 24 hours to indicate absence of complications and evidence that the causative factor has passed.
- ☒ D. CT after 3 days showing necrosis and fluid collections.
- E. CT scan after 3 days showing absence of abscess formation.

**41. D.** CT scan after 3 days showing necrosis and fluid collections.

The Balthazar CT staging system grades pancreatitis based on the presence of gland enlargement and/or fluid collections, as well as the presence of necrosis involving <30%, 30–50% or >50% of the gland. This has been shown to be a more accurate predictor of severity of pancreatitis and morbidity than the Ranson or Acute Physiology and Chronic Health Evaluation II (APACHE II) criteria. This staging system is, however, most accurate when carried out after 48 hours, as the degree of pancreatic necrosis may not be apparent before this.

**45. A 30-year-old man undergoes CT of the abdomen following a high-velocity collision during an RTA. The scan reveals peripancreatic fat stranding and a superficial laceration in the tail of the pancreas, which extends to less than 50% of the pancreatic thickness. What is the next most appropriate step?**

- A. Laparotomy.
- B. ERCP.
- C. Supportive therapy.
- D. Ultrasound to assess the pancreatic duct.
- E. Diagnostic peritoneal lavage.



**45. C. Supportive therapy.**

Injury to the pancreas is relatively uncommon, occurring in less than 2% of blunt abdominal trauma patients. Direct signs of pancreatic injury at CT include laceration, transection, enlargement, and inhomogenous enhancement. Secondary signs include peripancreatic fat stranding and fluid collections, haemorrhage, and thickening of the anterior pararenal fascia. The management of pancreatic trauma depends on the integrity of the pancreatic duct. If it is intact, the treatment is supportive and expectant. If the duct is disrupted, surgery or stenting at ERCP is required. Although CT may not always directly demonstrate the pancreatic duct, the likelihood of ductal injury may be inferred from secondary signs. Wong et al. have devised a CT grading scheme, which is similar to the surgical classification of Moore. Grade A injuries comprise pancreatitis or superficial laceration (<50% pancreatic thickness), grade B1 is deep laceration

(>50% pancreatic thickness), grade B2 is transection of the pancreatic tail, grade C1 is deep laceration of the pancreatic head, and grade C2 is transection of the pancreatic head.

Grade A injuries spare the duct and are usually seen with an intact duct by surgical grading. Grade B and C injuries correlate with duct disruption. MR pancreatography is an alternative to ERCP to assess the integrity of the pancreatic duct. The duct integrity cannot be reliably assessed by ultrasound, particularly in the context of recent trauma.

**46. An adolescent complains of chest and abdominal pain after suffering a handlebar injury whilst out riding his bicycle. He undergoes a CT scan of abdomen, as the surgical team fear he may have suffered a liver or splenic injury. In the recent past he has been complaining of loose motions and his mother has noticed he has failed to thrive. He has a long history of respiratory disease, which has been diagnosed as asthma. The CT scan shows low attenuation (–90 to –120 HU) in the region of the pancreas and air-trapping and cystic bronchiectasis in the upper lobes of both lungs. Which of the following is the most likely underlying pathological process explaining the appearance of the pancreas?**

- A. Chronic pancreatitis.
- B. Congenital absence of the pancreas.
- C. Lipomatous pseudohypertrophy of the pancreas.
- D. Gluten enteropathy.
- E. Shwachman–Diamond syndrome.

**46. C.** Lipomatous pseudohypertrophy of the pancreas.

The history is one of undiagnosed cystic fibrosis (CF), with respiratory disease and pancreatic exocrine dysfunction. Pancreatic involvement in CF initially produces inhomogenous attenuation, then low attenuation, and then complete fatty infiltration and replacement. Microcysts may develop and some of these may become small macroscopic cysts demonstrable with CT. There may be scattered calcifications. On ultrasound, there is increased diffuse echogenicity in keeping with fatty infiltration and fibrosis. CF is a major cause of pancreatic exocrine failure in childhood. Pancreatic abnormalities are seen in 85–90% of CF patients. However, the disease progresses to pancreatitis in less than 1% of CF patients. It predisposes to pancreatic cancer.

Shwachman–Diamond syndrome is a rare congenital disorder characterized by pancreatic exocrine insufficiency, bone marrow dysfunction, and skeletal abnormalities. Patients usually present in infancy or early childhood with malabsorption and recurrent infections. Imaging reveals pancreatic lipomatosis.

**48. A 58-year-old man with a history of alcohol abuse and diabetes presents with painless jaundice. Liver function tests reveal an obstructive picture and he undergoes an ultrasound of abdomen, which reveals dilatation of the CBD and a hypoechoic region in the head of the pancreas. He has a history of iodine allergy and undergoes MRI with dynamic gadolinium enhancement, as an alternative to contrast-enhanced CT. Which finding in the pancreatic head is most in keeping with the diagnosis of pancreatic adenocarcinoma?**

- A. Hypointensity on T1WI.
- B. Hyperintensity on T2WI.
- C. Hyperintensity on a STIR sequence.
- D. Hypointensity during arterial phase enhancement.
- E. Hypointensity during portal venous phase enhancement.

**48. D.** Hypointensity during arterial phase enhancement.

Pancreatic adenocarcinoma is generally a hypovascular tumour at CT as well as MRI. Dynamic contrast-enhanced CT has been the gold standard for the diagnosis of pancreatic adenocarcinoma, but MRI is of value in those with renal failure or sensitivity to iodine-based contrast media. Care should be taken in patients with a very low GFR (typically less than 30ml/min) because of the risk of nephrogenic systemic fibrosis. Contrast-enhanced MRI may have a lower false negative rate than CT, as approximately 10% of pancreatic adenocarcinomas have been shown to be iso- rather than hypoattenuating, on both the pancreatic and portal venous phases. Chandarana et al. have reported that 25 of 25 neoplasms showed hypointensity during arterial phase enhancement (and 20 remained hypointense in venous phase), whereas only 12 of 25 were hypointense on unenhanced T1WI, and only 11 of 25 were hyperintense on STIR/T2WI.



**49. A 42-year-old man is referred for a CT scan by an upper GI surgeon. He has a long history of recurrent upper abdominal pain, with more recent episodic vomiting. CT shows excess soft-tissue thickening between the head of pancreas and duodenum. Small cystic lesions are seen along the medial wall of the duodenum. There is also mild dilatation of the common bile duct and distension of the stomach and proximal duodenum. What is the most likely diagnosis?**

- A. Autoimmune pancreatitis.
- B. Groove pancreatitis.
- C. Pancreatitis related to ectopic or heterotopic pancreatic tissue.
- D. Hereditary pancreatitis.
- E. Pancreas divisum associated pancreatitis.

**49. B. Groove pancreatitis.**

This is a rare form of chronic pancreatitis. It occurs due to inflammation in the pancreaticoduodenal groove, the potential space between the pancreas, duodenum, and common bile duct. The clinical manifestations are primarily due to duodenal and biliary obstruction. The small cystic lesions in the duodenal wall refer to cystic dystrophy of the duodenum, which can be associated with groove pancreatitis.

Autoimmune pancreatitis generally shows a diffusely enlarged gland with loss of lobular architecture, a 'sausage' shape, and a peripheral 'rind' of hypoattenuation. There is usually a non-dilated or diffusely narrowed pancreatic duct and a distal biliary stricture.

Hereditary pancreatitis has a young age of onset of typical features of pancreatitis, with at least two acute attacks without an underlying cause.

Pancreas divisum associated pancreatitis is seen in young or middle-aged patients with recurrent acute pancreatitis or chronic relapsing pancreatitis. MRCP or ERCP are optimal for the diagnosis of the lack of communication between the ventral and dorsal pancreatic ducts.

Although ectopic pancreatic tissue is a proposed cause of groove pancreatitis, the ectopic or heterotopic tissue is most commonly seen in relation to the gastric wall.

- 1 A 42 year old man presents with severe central abdominal pain and a raised serum amylase. 4 days later, extremely ill, the patient undergoes a CT of the abdomen which demonstrates that only the head and uncinate process of the pancreas are enhancing and there is extensive free fluid in the peri-pancreatic tissues.

**How would you interpret these findings?**

- (a) Acute pancreatitis
- (b) Acute pancreatitis with necrosis
- (c) Acute pancreatitis with infected necrosis
- (d) Acute pancreatitis with abscess
- (e) Acute pancreatitis with pseudocyst formation

1 (b)

The clinical scenario and imaging features clearly indicate acute pancreatitis. Areas of non-enhancement  $>3$  cm, or  $>30\%$  of the pancreatic volume are considered reliable CT signs for necrosis. Imaging too early in the clinical course will reduce the sensitivity of CT for evaluating pancreatic necrosis. Sepsis tends to complicate severe pancreatitis after the first 1–2 weeks, peaking at 3 weeks, and is a common cause of mortality in these patients. A discrete abscess is less common but is suggested by the development of air within a collection. Pseudocysts are common sequelae of acute pancreatitis but take at least 4 weeks to form.

- 8** An 18 year old male patient with known von Hippel Lindau disease is referred for abdominal imaging.

**Which of the following conditions would you not expect to see in association with this disease?**

- (a) Pheochromocytoma
- (b) Serous cystadenoma of the pancreas
- (c) Neuroendocrine pancreatic tumour
- (d) Pancreatic cysts
- (e) Adrenocortical carcinoma

**8 (e)**

There are a number of abdominal manifestations in addition to these including renal cysts and renal cell carcinoma. Epididymal papillary cystadenoma may be seen on scrotal US in male patients.

- 28** A 46 year old man presents with abdominal pain, fever and vomiting 5 weeks after an episode of acute pancreatitis. A CT study shows a well-circumscribed collection adjacent to the pancreas with an enhancing rim.

**What is the most likely diagnosis?**

- (a) Pseudocyst
- (b) Pancreatic abscess
- (c) Infective necrosis
- (d) Acute pancreatitis
- (e) Chronic pancreatitis

**28 (b)**

A pancreatic abscess complicates 3% of cases of acute pancreatitis and is due to infection within a fluid collection such as a pseudocyst. Such abscesses may be found anywhere within the abdomen or pelvis and require percutaneous drainage.



**36 Which of the following is true of insulinomas?**

- (a) Men are affected twice as often as women
- (b) Multiple lesions are seen in 25% cases
- (c) They account for 25% of pancreatic endocrine tumours
- (d) They are associated with MEN-I syndrome
- (e) Approximately 25% cases are malignant

**36 (d)**

Endocrine tumours account for 1-2% of all pancreatic tumours and insulinoma is the most common of these, representing 60% of cases. Approximately 5-10% are malignant; these tend to be the larger lesions (>5 cm). However, most lesions are less than 1.5 cm at presentation and only 5-10% cases have multiple lesions.

**38 A patient with a 4 month history of severe upper abdominal pain undergoes an endoscopic US. This reports a combination of echogenic and echo-poor foci throughout the pancreas, an irregular contour of the pancreatic duct and thickening of the duct wall with some side duct dilatation.**

**What is the most likely diagnosis?**

- (a) Autoimmune pancreatitis
- (b) Pancreatic adenocarcinoma
- (c) Intraductal papillary mucinous tumour
- (d) von Hippel Lindau syndrome
- (e) Chronic pancreatitis

**38 (e)**

These are the typical findings of chronic pancreatitis at endoscopic ultrasound.

**40 Which of the following is associated with an increased risk of developing pancreatic adenocarcinoma?**

- (a) Hereditary pancreatitis
- (b) High alcohol consumption
- (c) High coffee consumption
- (d) Low fibre diet
- (e) Type-1 diabetes mellitus

**40 (a)**

There is a 70-fold increase in pancreatic adenocarcinoma in this condition. Dietary factors play no role, but cigarette smoking is associated. Diabetes mellitus may be a presenting feature, but is not associated with an increased risk of malignancy.

**4 A 58 year old lady undergoes a CT of the abdomen and pelvis which identifies a 4 cm cyst within the pancreas. Endoscopic US-FNA shows a unilocular cyst and yields fluid with high amylase and lipase but low CEA antigen levels.**

**What is the diagnosis?**

- (a) Serous cystadenoma
- (b) Mucinous cystadenoma
- (c) Intraductal papillary mucinous neoplasm
- (d) Mucinous cystadenocarcinoma
- (e) Pseudocyst

**4 (e)**

These are typical findings; there may or may not be a clear history of pancreatitis. An elevated CEA >200 ng/ml is an indicator of malignancy.

**8 Regarding pancreas divisum, which of the following statements is true?**

- (a) The dorsal pancreas drains via the major papilla
- (b) Pancreatic drainage is *via* the duct of Santorini
- (c) The dorsal and ventral pancreas drain via the same channel
- (d) The common bile duct and dorsal pancreas drain via the same channel
- (e) The major papilla lies proximal to the minor papilla

**8 (b)**

Dorsal and ventral pancreas drain separately in to the duodenum *via* the minor and major papillae respectively.

**11 A 51 year old lady with recurrent episodes of central abdominal pain undergoes a CT study. This is reported to show diffuse enlargement of the pancreas with a peripancreatic 'halo'.**

**What is the most likely diagnosis?**

- (a) Intraductal papillary mucinous neoplasm
- (b) Autoimmune pancreatitis
- (c) Chronic pancreatitis
- (d) Primary pancreatic lymphoma
- (e) Acute pancreatitis

**11 (b)**

This is a typical clinical presentation and characteristic imaging finding. The diagnosis needs to be confirmed histopathologically and then treated with corticosteroids, unlike other forms of pancreatitis. Relapse is well documented. Patients may progress to develop biliary complications, atrophy and chronic symptoms.

- 42 A 42 year old man undergoes a CT of the abdomen which demonstrates the presence of a 4 cm diameter cystic lesion in the pancreas. Further evaluation with endoscopic US demonstrated that the lesion comprises innumerable small cysts each less than 15 mm in diameter.**

**What is the most likely diagnosis?**

- (a) Serous cystadenoma
- (b) Pseudocyst
- (c) Intraductal papillary mucinous neoplasm
- (d) Mucinous cystadenoma
- (e) Mucinous cystadenocarcinoma

**42 (a)**

This is the typical appearance of this benign cystic lesion, formerly referred to as a microcystic tumour. Mucinous tumours tend to produce larger cysts and IPMN may extend along the main or side pancreatic ducts. A pseudocyst is often unilocular but may contain debris.

- 50 A 45 year old female patient undergoes simultaneous pancreas and kidney transplantation. A Doppler US of the pancreatic graft 1 week later shows a normal systolic flow but complete reversal of diastolic blood flow in the artery.**

**What is the most likely diagnosis?**

- (a) Arterial thrombosis
- (b) Acute rejection
- (c) Acute pancreatitis
- (d) Venous thrombosis
- (e) Arterio-venous shunt

**50 (d)**

This is the effect of the entire blood supply to the graft passing back and forth through the artery and is well recognised in pancreatic or renal transplantation. This requires prompt intervention and may result in graft loss.

- 71 A 45 year old man is referred for abdominal imaging with a history of watery diarrhoea, hypokalaemia and achlorhydria. CT imaging demonstrates a 4 cm diameter lesion within the pancreas which demonstrates uptake of  $^{111}\text{In}$ -pentetreotide at scintigraphy.

**What is the most likely diagnosis?**

- (a) Insulinoma
- (b) Gastrinoma
- (c) Glucagonoma
- (d) VIPoma
- (e) Somatostatinoma

**71 (d)**

These are the characteristic clinical features (Verner-Morrison syndrome) associated with these uncommon tumours. 90% of tumours are intrapancreatic and they measure 2–7 cm at diagnosis. Extrapaneatic lesions are usually benign, but 50% of pancreatic lesions are malignant. Lesions also take up  $^{123}\text{I}$ -VIP.



79) A 45-year-old man is admitted after a road traffic accident in which he sustained abdominal injuries. After fluid resuscitation he undergoes CT of the abdomen and pelvis with intravenous contrast. This demonstrates a serpiginous area of attenuation value 130 HU at the splenic hilum with surrounding lower-attenuation material. What is this most likely to represent?

- a. active arterial extravasation
- b. acute clotted blood
- c. acute unclotted blood
- d. splenic arterial calcification
- e. ascites

79) a. \*\*\*\*

In the evaluation of haemoperitoneum by CT, attenuation values can help differentiate ascites, unclotted blood, active bleeding and haematoma. Blood usually has a higher measured attenuation than other body fluids, but its appearance depends on the age, extent and location of haemorrhage. **Unclotted blood** has an attenuation value of 30–45 HU, but this may be lower in patients with a lower serum haematocrit and if the haemorrhage is more than 48 hours old. **Clotted blood** has an attenuation value of 45–70 HU, and identification of the area of highest-attenuation haematoma (sentinel clot) on CT indicates the site of bleeding. **Active arterial extravasation** is seen as an area of higher attenuation resembling that in the aorta, ranging from 85 HU to 370 HU. It may be surrounded by lower-attenuation haematoma. This finding indicates the need for urgent embolization or surgical treatment.

2. A 32 year old male front seat passenger is involved in a road traffic accident and sustains blunt abdominal trauma. He is admitted via the emergency department and CT reveals a splenic laceration with subcapsular haematoma. Which one of the following associated injuries is most likely to be found?
- a. Diaphragmatic rupture
  - b. Injury to the liver
  - c. Injury to the left kidney
  - d. Ipsilateral rib fractures
  - e. Injury to the small bowel mesentery

2. d. Ipsilateral rib fractures

All are potential associated injuries and should be actively searched for in the context of blunt abdominal trauma. Rib fractures are found in up to 50% of patients with splenic injuries and as such are the most common association. The left kidney is injured in 10% of patients with splenic injury, and diaphragm rupture is even rarer. Diaphragm rupture may be difficult to appreciate on axial slices, and may be more evident on coronal reformats.

- 17 A patient was found unconscious with external signs of abdominal trauma. A CT of their abdomen demonstrated an abnormality around the duodenum with surrounding fluid and further free fluid in the pelvis. The fluid surrounding the duodenum had a measured density of 80 HU. What is this measured area most likely to represent?
- a Active bleeding
  - b Fresh unclotted blood
  - c Clotted blood
  - d Urine
  - e Bile

17 Answer C: Clotted blood

Serum: 0–20 HU, Fresh unclotted blood: 30–45 HU, Clotted blood: 60–100 HU:  
Active arterial extravasation >180 HU (on enhanced scan).

- 21 A young man was involved in a fight in a fast food outlet and was stabbed in the abdomen with a large knife. A CT of his chest, abdomen and pelvis showed a duodenal laceration with associated pneumoperitoneum and intraperitoneal free fluid. What other organ is most likely to have been injured?
- a Colon
  - b Liver
  - c Pancreas
  - d Small bowel
  - e Spleen

21 Answer B: Liver

Duodenal injury is frequently associated with injury to other abdominal structures. The pattern of these associated injuries varies between blunt and penetrating trauma:

blunt trauma: pancreas > liver > spleen > colon > small bowel > kidney.

penetrating trauma: liver > pancreas > small bowel > kidney > colon > spleen.

- 22 A 17-year-old was a rear-seat passenger in a head-on vehicle collision with a combined speed of 120mph in which the drivers both died at the scene. The patient was wearing a seatbelt and was not ejected from the vehicle. After being cut from the vehicle the patient was airlifted to hospital where a multi-trauma CT was performed. In addition to significant head and chest trauma there was intraperitoneal free fluid and some bubbles of extraluminal intraperitoneal free gas just beyond the ligament of Treitz. There was also duodenal and jejunal wall thickening. What is the most likely diagnosis?
- a Jejunal injury with disruption of the bowel wall
  - b Duodenal injury with disruption of the bowel wall
  - c Bowel oedema secondary to hypovolaemic shock
  - d Blunt injury causing contusion of the jejunum and duodenum
  - e Pancreatic contusion

22 Answer A: Jejunal injury with disruption of the bowel wall

The most common site of traumatic small bowel injury is the anti-mesenteric border of the proximal jejunum. Blunt abdominal trauma causing hollow viscous injuries occurred in conjunction with multiple trauma in approximately 70% of cases. Bubbles of gas are often seen close to the affected segment; wall disruption will most likely be present if free gas is present.

- 38 A front-seat passenger in a head-on collision was brought to the Emergency Department. A contrast-enhanced CT of their abdomen and pelvis showed a liver laceration in segment 6 that is 2 cm deep and 8 cm long. What grade is appropriate?
- a Grade I laceration
  - b Grade II laceration
  - c Grade III laceration
  - d Grade IV laceration
  - e Grade V laceration

38 Answer B: Grade II laceration

- 67 A young boy presented after hitting the handlebars of his push bike. Imaging demonstrated pancreatic parenchymal damage that did not involve the main pancreatic duct. What is the most likely site of injury?
- a Pancreatic head
  - b Uncinate process
  - c Pancreatic tail
  - d Junction of head and neck
  - e Junction of body and tail

67 Answer E: Junction of body and tail

- 45 A young man fell 3.5 metres from a ladder and presented with severe left-sided abdominal pain. He was haemodynamically stable. Plain X-rays of the chest and abdomen were unremarkable except for multiple left-sided rib fractures. Contrast-enhanced CT of the abdomen showed a subcapsular Grade 2 splenic haematoma. How much of the spleen is likely to be involved?
- a >50% of the surface area
  - b <25% of the surface area
  - c 25–50% of the surface area
  - d Completely shattered spleen
  - e <10% of the surface area

45 Answer C: 25–50% of the surface area

There are five grades of splenic injury depending on surface area involved, depth of laceration and vascular involvement.

67 A young boy presented after hitting the handlebars of his push bike. Imaging demonstrated pancreatic parenchymal damage that did not involve the main pancreatic duct. What grade of injury has he suffered?

- a Grade I injury
- b Grade II injury
- c Grade III injury
- d Grade IV injury
- e Grade V injury

67 Answer B: Grade II injury

Grade I: Minor contusion/haematoma, capsule and major duct intact

Grade II: Parenchymal injury without major duct injury

Grade III: Major ductal injury

Grade IV: Severe crush injury

20 A 31-year-old man was involved in a high-speed road accident and sustained significant chest and head injuries. He was admitted to ITU and a chest radiograph obtained 24 hours later showed pneumoperitoneum. An occult gut injury was suspected. What part of the gut is most likely to have been injured?

- a Gastro-oesophageal junction
- b Duodenum
- c Ileum
- d Colon
- e Rectum

20 Answer B: Duodenum

Ninety-five per cent of intestinal trauma occurs in the duodenum and proximal jejunum. The remaining 5% occurs in the colon. Blunt intestinal trauma at other sites is rare.



65 An eight-year-old boy was admitted after falling onto the handle bars of his bike and then onto the road. In addition to significant musculoskeletal injuries he complained of abdominal pain and on examination had a rigid abdomen with minimal bowel sounds. An ultrasound of the abdomen showed a small amount of intra-abdominal free fluid and as he was becoming more unwell an urgent CT was performed. This showed oedema in the peri-pancreatic fat and irregularity of the pancreatic contour. A discrete ill-defined area of low attenuation was seen in the region of the junction of the body and tail and there was bilateral thickening of the para-renal fascia. There was no appreciable loss of gland volume and pancreatic duct was normal. What is the most likely conclusion on the basis of these imaging findings?

- a Major ductal injury
- b Major vascular injury
- c Pancreatic contusion
- d Parenchymal injury with haemorrhage without major duct disruption
- e Post-traumatic pancreatitis

65 Answer C: Pancreatic contusion

The area of low attenuation with the gland is consistent with a parenchymal contusion. If haemorrhage was present this would probably be of increased attenuation.

7. A 24-year-old male patient is brought into A&E following a high-speed RTA. His blood pressure was 90/60 mmHg and his heart rate was 112 on admission, but these observations respond well to intravenous fluids and the patient has remained stable since. He complains of left-sided abdominal pain. A pneumothorax is noted on CXR, with associated left-sided rib fractures. An urgent CT scan of chest and abdomen is carried out. This reveals fluid in the abdomen. A crescentic area of low attenuation is noted around the spleen. There is a further area of hypoattenuation passing 4 cm into the splenic parenchyma, adjacent to the hilum. The rest of the splenic parenchyma is of uniform attenuation. The CT also shows a flail segment of chest and an area of lung contusion at the left base. Which of the following statements with regard to the spleen is true?

- A. The appearances described represent subcapsular haematomas.
- B. The appearances described represent a haematoma and a parenchymal laceration. The presence of free fluid represents acute haemorrhage and a laparotomy is indicated.
- C. The appearances are consistent with a shattered spleen as the laceration extends to the hilum.
- D. The appearances are consistent with a subcapsular haematoma and a splenic laceration. Conservative management is appropriate with serial CT scans.
- E. Whilst the appearances are consistent with a laceration and subcapsular haematoma, radiological findings are not reliable in determining the need for a laparotomy.

7. E. Whilst the appearances are consistent with a laceration and subcapsular haematoma, radiological findings are not reliable in determining the need for a laparotomy.

Splenic injuries can be graded 1–5 (American Association of Trauma Surgeons). Grade 1 is a subcapsular haematoma that involves <25% of the splenic surface or a laceration <1cm deep. Grade 2 is a haematoma that involves 25–50% of the surface or a laceration up to 3cm deep. Grade 3 is a haematoma involving >50% of splenic surface or 10 cm in length or a laceration greater than 3 cm into the parenchyma. Grade 4 is a laceration extending into the hilum that devascularizes up to 25% of the spleen. Grade 5 is a shattered spleen, with multiple lacerations or a spleen avulsed from its vascular bed. Radiological findings do not correlate well with requirement for laparotomy in the more minor splenic injuries. Clinical assessment is of more value, with surgery only indicated in unstable patients. The value of radiology is in detecting other injuries and in quantifying the amount of the haematoma due to the risk of delayed splenic rupture in more severe injuries.

**45. A 30-year-old man undergoes CT of the abdomen following a high-velocity collision during an RTA. The scan reveals peripancreatic fat stranding and a superficial laceration in the tail of the pancreas, which extends to less than 50% of the pancreatic thickness. What is the next most appropriate step?**

- A. Laparotomy.
- B. ERCP.
- C. Supportive therapy.
- D. Ultrasound to assess the pancreatic duct.
- E. Diagnostic peritoneal lavage.

**45. C. Supportive therapy.**

Injury to the pancreas is relatively uncommon, occurring in less than 2% of blunt abdominal trauma patients. Direct signs of pancreatic injury at CT include laceration, transection, enlargement, and inhomogenous enhancement. Secondary signs include peripancreatic fat stranding and fluid collections, haemorrhage, and thickening of the anterior pararenal fascia. The management of pancreatic trauma depends on the integrity of the pancreatic duct. If it is intact, the treatment is supportive and expectant. If the duct is disrupted, surgery or stenting at ERCP is required. Although CT may not always directly demonstrate the pancreatic duct, the likelihood of ductal injury may be inferred from secondary signs. Wong et al. have devised a CT grading scheme, which is similar to the surgical classification of Moore. Grade A injuries comprise pancreatitis or superficial laceration (<50% pancreatic thickness), grade B1 is deep laceration

(>50% pancreatic thickness), grade B2 is transection of the pancreatic tail, grade C1 is deep laceration of the pancreatic head, and grade C2 is transection of the pancreatic head.

Grade A injuries spare the duct and are usually seen with an intact duct by surgical grading. Grade B and C injuries correlate with duct disruption. MR pancreatography is an alternative to ERCP to assess the integrity of the pancreatic duct. The duct integrity cannot be reliably assessed by ultrasound, particularly in the context of recent trauma.



7) A 54-year-old woman with a sensation of incomplete evacuation on defecation undergoes conventional defecography. Following introduction of barium paste into the rectum, in which position should the patient be placed for imaging?

- a. supine
- b. prone
- c. left lateral
- d. right lateral
- e. sitting

7) e. \*\*

Conventional defecography is used in the imaging evaluation of obstructed defecation. Barium paste is instilled into the rectum with a Foley catheter, with the patient in the left lateral position. Prior opacification of the small bowel, bladder, vagina or peritoneum may also be performed to aid diagnosis. With the patient sitting on a commode placed on the footrest of a standard fluoroscopic table, static images are first obtained at rest and with contraction of the pelvic floor muscles. A cine-loop of evacuation is then obtained until the rectum is empty or three 30-second attempts at evacuation have been made. A variety of conditions may be demonstrated, including rectocele, enterocele, rectal intussusception and anismus.

8) A 68-year-old woman presents with small bowel obstruction, and undergoes contrast-enhanced CT of the abdomen. This demonstrates dilated small bowel to the level of the mid-ileum, where a herniated loop of small bowel is seen emerging inferolateral to the left pubic tubercle. What is the most likely cause of small bowel obstruction in this patient?

- a. femoral hernia
- b. indirect inguinal hernia
- c. direct inguinal hernia
- d. spigelian hernia
- e. obturator hernia

8) a. \*\*\*\*

External hernias are the second most common cause of small bowel obstruction after adhesions. A femoral hernia protrudes through the femoral ring, lying medial to the femoral vein, which may be compressed. On CT the hernia is seen inferolateral to the pubic tubercle, in contrast to inguinal hernias, which usually lie superomedial to the tubercle, though differentiation may be difficult in non-incarcerated cases. Femoral hernias are more prone to incarceration due to the inflexible margins of the femoral ring. Inguinal hernias may be classified as indirect (passing down the inguinal canal, seen lateral to the inferior epigastric vessels) or direct (protruding directly through the lower abdominal wall medial to the inferior epigastric vessels). A spigelian hernia protrudes through a defect in the inferolateral anterior abdominal wall. Obturator hernias protrude through the obturator foramen, between the pectineus and external obturator muscles.

11) Which venous structure divides the liver into the right and left lobes?

- a. right hepatic vein
- b. middle hepatic vein
- c. left hepatic vein
- d. left portal vein
- e. right portal vein

11) b. \*\*\*

The functional segmental anatomy of the liver is based on the distribution of the three major hepatic veins. The middle hepatic vein divides the liver into left and right lobes. The left hepatic vein divides the left lobe into medial and lateral segments. The right hepatic vein divides the right lobe into anterior and posterior segments. In addition, the four sections are further subdivided in a transverse plane by an imaginary line drawn between the right and left portal veins. Segments run in a clockwise fashion, with segments III, IV(b), V and VI lying below the portal veins and segments VII, VIII, IV(a) and II lying above. The caudate lobe (segment I) lies posterior and to the right of the inferior vena cava.



12) What is the primary imaging investigation for staging of colon cancer diagnosed at colonoscopy?

- a. CT of the abdomen and pelvis
- b. CT of the thorax, abdomen and pelvis
- c. abdominal ultrasound scan
- d. double-contrast barium enema
- e.  $^{18}\text{F}$ FDG PET/CT

12) b. \*\*

Patients with colon cancer diagnosed endoscopically or suspected following barium enema should be imaged for staging purposes.

Objectives of staging include determination of size and local extent of tumour, assessment of the extension of tumour into adjacent structures, and detection of local and distant nodal involvement and presence of metastatic disease. Abdominal ultrasound scan alone is not considered sufficient, and CT of the chest, abdomen and pelvis with oral and intravenous iodinated contrast medium is the primary imaging investigation. The liver is the commonest site of distant metastases, but pulmonary metastases occur in 5–50% of patients.  $^{18}\text{F}$ FDG PET/CT is not used in initial staging but is particularly useful for detecting recurrent disease.

18) A 70-year-old man presents with fresh bleeding per rectum. He undergoes resuscitation, receiving 5 units of blood over the following 24 hours. Colonoscopy is unsuccessful in detecting the source of the bleeding, and he continues to pass fresh blood, although he remains haemodynamically stable. What is the most appropriate next investigation?

- a.  $^{99m}\text{Tc}$ -labelled red blood cell radionuclide imaging
- b. CT angiography
- c. repeat colonoscopy
- d. digital subtraction mesenteric angiography
- e. abdominal ultrasound scan

18) b. \*\*\*\*

Several imaging methods are available for use in those patients in whom endoscopy fails to detect the source of bleeding in gastrointestinal haemorrhage. **Radionuclide imaging** is non-invasive and very sensitive, detecting bleeding rates as low as 0.1–0.5 ml/min. Images are acquired over several hours, enabling detection of intermittent and venous bleeding, but anatomical localization can be insensitive and variable. **Conventional angiography** is invasive and requires active bleeding at the time of both imaging and contrast injection. Higher bleeding rates of 0.5–1 ml/min are required, and motion artefact from bowel peristalsis may be problematic, but it provides superior localization of the bleeding site and options for therapeutic intervention. However, **CT angiography**

is advocated as the most appropriate investigation, due to its wide availability, minimal invasiveness and high sensitivity, detecting bleeding rates as low as 0.3 ml/min in animal models. In addition, it enables assessment of a pathological lesion causing bleeding, which may be helpful in planning further management.

31) A 23-year-old man presents with acute lower abdominal pain. An abdominal radiograph demonstrates a rounded, laminated calcific density projected over the right lower quadrant. What is the approximate likelihood of a diagnosis of acute appendicitis?

- a. 10%
- b. 30%
- c. 50%
- d. 70%
- e. 90%

31) e. \*\*\*

A laminated calcified appendicolith is seen in only 7–15% of patients with acute appendicitis. However, the presence of acute abdominal pain with an appendicolith on abdominal plain film indicates a 90% probability of acute appendicitis, and also indicates a high probability of gangrene/perforation. Other plain film signs of acute appendicitis include caecal wall thickening, small bowel obstruction and focal extraluminal gas collections.

35) A 72-year-old man attends for a barium enema examination. He has no known allergies. In considering administration of intravenous hyoscine-N-butylbromide (Buscopan), which factor in his medical history is it most important to be aware of?

- a. prostatism
- b. type I diabetes
- c. glaucoma
- d. migraine
- e. unstable cardiac disease



35) e. \*\*\*\*

Buscopan is commonly used in radiological practice as a smooth muscle relaxant. As a non-selective muscarinic antagonist, it produces other autonomic responses including pupillary dilatation and tachycardia, and may potentially precipitate an attack of acute angle-closure glaucoma that requires prompt treatment to prevent permanent visual loss. However, most glaucoma is of the open-angle form, which is unaffected by Buscopan, and it is therefore advised that routine enquiry about a history of glaucoma is unnecessary. Instead patient information leaflets should advise all patients to attend hospital immediately should they develop painful, blurred vision. Routine enquiry about prostatic disease, porphyria and myasthenia gravis is also not recommended. However, in patients with unstable cardiac disease, the tachycardia and slight increase in diastolic blood pressure caused by Buscopan carry the potential risk of arrhythmia. The presence of unstable cardiac disease is therefore deemed to be the only potential reason to withhold Buscopan.

40) Which anatomical structure separates the right and left subphrenic spaces?

- a. gastrohepatic ligament
- b. foramen of Winslow
- c. falciform ligament
- d. Morison's pouch
- e. lesser omentum

40) c. \*\*\*\*

The right subphrenic space is in communication around the liver with the anterior subhepatic and posterior subhepatic (Morison's pouch) spaces. The right subphrenic and subhepatic spaces communicate freely with the right paracolic gutter and via this with the pelvic peritoneal cavity. The left subphrenic space communicates with the left subhepatic space but is separated from the right subphrenic space by the falciform ligament and from the left paracolic gutter by the phrenicocolic ligament. The falciform ligament is a sickle-shaped fold of peritoneum that attaches the ventral surface of the liver to the anterior abdominal wall. It extends in a parasagittal plane from the umbilicus to the diaphragm and carries the ligamentum teres in its free inferoposterior margin. The lesser sac is an isolated peritoneal compartment between the stomach and pancreas, which communicates with the rest of the peritoneal cavity (greater sac) only through the foramen of Winslow (epiploic foramen). The lesser omentum is composed of the gastrophatic and hepaticoduodenal ligaments and suspends the stomach and duodenal bulb from the inferior liver surface.

41) A 74-year-old man presents with severe abdominal pain and is admitted under the surgical team with suspected perforation. He is too unwell to undergo an erect chest radiograph. What is the most appropriate alternative plain film to detect the presence of free intraperitoneal gas?

- a. supine chest
- b. erect abdomen
- c. supine abdomen
- d. left lateral decubitus abdomen
- e. right lateral decubitus abdomen



41) d. \*\*\*

An erect chest radiograph is best for demonstrating a small pneumoperitoneum, enabling the identification of as little as 1 ml of free intraperitoneal gas. It is superior to an erect abdomen, as the X-ray beam penetrates the diaphragmatic region almost tangentially, whereas, in an erect abdomen, the divergent beam penetrates this area obliquely. However, if the patient is too unwell to sit erect, the most appropriate projection is a left lateral decubitus abdominal radiograph, performed with the patient lying on the left side, using a horizontal X-ray beam. In this position, air will preferentially leave a perforated duodenal or antral ulcer, and any free gas in the lesser sac will enter the main abdominal

cavity. The supine abdominal radiograph may demonstrate free gas in about 56% of patients with pneumoperitoneum. Characteristic features include gas outlining both inner and outer walls of a bowel loop (Rigler's sign), triangular collections of gas between bowel loops, and outlining of the falciform ligament and other peritoneal reflections by free gas. The supine chest radiograph is not useful in the detection of free intraperitoneal gas.

43) The gastroduodenal artery normally has its origin from which vessel?

- a. superior mesenteric artery
- b. common hepatic artery
- c. left gastric artery
- d. coeliac axis
- e. aorta

43) b. \*\*\*

In 75% of cases, the gastroduodenal artery arises from the common hepatic artery before its division into right and left branches. Less common origins include the left hepatic artery (4–11%), the right hepatic artery (7%) and the superior mesenteric artery via a replaced hepatic trunk (4–11%). The artery descends behind the first part of the duodenum, lying anterior to the pancreas and to the left of the common bile duct. At this site, erosion of the posterior duodenal wall by an ulcer may produce life-threatening haemorrhage if the gastroduodenal artery is involved. Its main branches are the posterior and anterior superior pancreaticoduodenal arteries, and the right gastroepiploic artery.

54) Which of the following may improve the detection of Meckel's diverticulum on a [ $^{99m}\text{Tc}$ ] pertechnetate study?

- a. prior administration of cimetidine
- b. prior administration of laxatives
- c. prior administration of potassium perchlorate
- d. maintenance of a full bladder
- e. barium follow-through prior to study

54) a. \*\*\*\*

Cimetidine, a histamine  $\text{H}_2$ -receptor antagonist, may be used to increase uptake of [ $^{99m}\text{Tc}$ ] pertechnetate by inhibiting its secretion from gastric mucosa. Pentagastrin and glucagon have also been used to improve visualization, by stimulating uptake and decreasing peristalsis respectively. Procedures such as colonoscopy and use of laxatives should be avoided prior to the scan, as they may cause mucosal irritation. Potassium perchlorate should not be used to block thyroid uptake, as it also blocks uptake of pertechnetate by the gastric mucosa. The patient normally fasts for 3–4 hours and voids prior to the study, as a full stomach or bladder may obscure an adjacent Meckel's diverticulum. Barium studies should be avoided for 3–4 days prior to the study, as attenuation by the barium may hamper interpretation.

57) In patients with cystic fibrosis, which gastrointestinal pathology may occur as a result of high-dose lipase supplementation?

- a. rectal prolapse
- b. fibrosing colonopathy
- c. pneumatosis intestinalis
- d. gastro-oesophageal reflux
- e. meconium ileus equivalent syndrome

57) b. \*\*\*\*

Fibrosing colonopathy is a condition causing progressive submucosal fibrosis predominantly affecting the proximal colon. It was first described in 1994 in children with cystic fibrosis taking high-dose lipase supplementation, to relieve the symptoms of exocrine pancreatic insufficiency. It causes stricturing and longitudinal shortening of the right colon, and patients present with obstruction. Overall, the gastrointestinal tract is affected in 85–90% of patients with cystic fibrosis, and all of the above pathologies may occur, though only fibrosing colonopathy is associated with high-dose lipase supplementation.

59) A transjugular intrahepatic portosystemic shunt lies between the portal vein and which vessel?

- a. hepatic vein
- b. inferior vena cava
- c. aorta
- d. common hepatic artery
- e. left gastric vein



59) a. \*\*\*\*

A transjugular intrahepatic portosystemic shunt (TIPSS) is an endovascular procedure performed to create a portosystemic shunt between the portal venous and hepatic venous systems, for decompression of portal hypertension, particularly in patients with variceal bleeding uncontrollable by endoscopic management. The shunt is normally formed between the right hepatic vein and right portal vein. The right internal jugular vein is accessed, and via this the right hepatic vein. Curved needle passes are made in an anterior direction to access the right portal vein. The portosystemic pressure gradient is measured and portal venography is performed to enable planning of stent placement. A stent is deployed following balloon dilatation of the stent tract. The goal is to decrease the portosystemic gradient to below 12 mmHg and to see no significant filling of varices. Portosystemic shunts require close follow-up, as there is a high incidence of shunt stenosis and occlusion.

63) During MRCP, which substance may be administered to improve visualization of the pancreatic ducts?

- a. glucagon  $\Rightarrow$   $\uparrow$  bile flow  $\rightarrow$  better visualisation of bile
- ☒ b. secretin  $\Rightarrow$  distension of pancreatic duct  $\Rightarrow$  used
- c. cholecystokinin  $\Rightarrow$  gallbladder contraction  $\Rightarrow$  hepatobiliary
- d. gastrin
- e. Buscopan

63) b. \*\*\*\*

Secretin is a hormone normally secreted by the duodenal mucosa in response to acid within the lumen. It has many physiological effects on the gastrointestinal tract, including stimulation of pancreatic secretions and a transient increase in tone of the sphincter of Oddi. When given intravenously immediately prior to imaging, it results in distension of the

pancreatic ductal system and can significantly improve visualization of the pancreatic main and branch ducts on MRCP, as well as provide information about the secretory reserve capacity of the pancreas. Effects on the biliary tree are less pronounced and not usually appreciable on imaging. Side effects include abdominal pain, bloating and diarrhoea. Glucagon increases bile flow and has been suggested to improve visualization of the biliary tree at MRCP. Cholecystokinin stimulates gallbladder contraction, and is sometimes used in hepatobiliary scintigraphy. Buscopan is widely used in imaging for its inhibition of intestinal motility.

65) Which is the most appropriate contrast medium for a barium follow-through examination of the small bowel?

- a. 100 ml of 250% w/v barium sulphate  $\Rightarrow$  barium swallow
- b. 135 ml of 250% w/v barium sulphate  $\Rightarrow$  barium meal
- c. 300 ml of 100% w/v barium sulphate
- d. 1500 ml of 20% w/v barium sulphate  $\Rightarrow$  small bowel enema
- e. 500 ml of 115% w/v barium sulphate  $\Rightarrow$  double barium contrast

65) c. \*\*\*

The recommended contrast is 300ml of 100% w/v barium sulphate. Transit time may be reduced by the addition of 10ml of Gastrografin to the barium. Non-ionic, water-soluble contrast media may be used as an alternative where barium is contraindicated. The recommended concentrations and volumes for the other gastrointestinal contrast examinations are barium swallow (a), barium meal (b), small bowel enema (d) and double-contrast barium enema (e).



77) At abdominal ultrasound scan, when scanning the abdomen in a transverse plane at the level of the pancreas, which of the following structures may normally be seen lying between the superior mesenteric artery and the aorta?

- a. splenic vein
- b. left renal vein
- c. neck of the pancreas
- d. inferior vena cava
- e. common bile duct

77) b. \*\*\*

Ultrasound scan of the pancreas may be difficult and vascular landmarks are important in its identification. In the transverse plane, the splenic vein can be seen coursing from the splenic hilum towards the liver, and the body and tail of the pancreas lie immediately anterior to this. The neck of the pancreas lies immediately anterior to the confluence of the splenic and superior mesenteric veins, and the head and uncinate process of the pancreas lie around this confluence, anterior to the inferior vena cava. At this level, the left renal vein can be seen entering the inferior vena cava, passing between the superior mesenteric artery and aorta.

78) A 67-year-old man undergoes Whipple's procedure for adenocarcinoma of the head of the pancreas. Which finding is of most concern on CT of the abdomen performed 4 days postoperatively for persistent pyrexia?

- a. free intraperitoneal gas
- b. aerobilia in the left intrahepatic ducts
- c. oral contrast within the afferent jejunal loop
- d. small thin-walled fluid collection in Morison's pouch
- e. gas-containing fluid collection in the pancreatic bed

78) e. \*\*\*\*

The two main indications for Whipple's procedure (radical pancreaticoduodenectomy) are tumour in the perampullary region, and chronic pancreatitis involving the head and uncinate process of the pancreas. Surgery is complex and involves gastrojejunostomy, pancreaticoenterostomy and choledochojejunostomy. Common post-operative findings include retroperitoneal fat stranding and transient, thin-walled fluid collections, which may be in the pancreatic bed, perianastomotic or in Morison's pouch. Free gas is common and aerobilia is seen in around 70% of cases, more commonly in the left intrahepatic ducts. Filling of the afferent jejunal loop with contrast is normal and occurs in up to 44% of patients. The commonest complications are delayed gastric emptying, pancreaticojejunal leak and sepsis. Anastomotic failure can occur at any of the sites, but the pancreaticoenterostomy is most important because of the risk of leakage of pancreatic secretions. Anastomotic leak is associated with increased free gas, perianastomotic fluid and ascites. Focal septic collections can occur anywhere, and complex or gas-containing areas are considered suspicious. Other early complications include vascular injury and thrombosis, *Clostridium difficile* colitis and pancreatitis of the pancreatic remnant.

80) In the staging of rectal cancer by MRI, which sequence provides optimum visualization of the tumour?

- a. T1W
- b. contrast-enhanced T1W
- c. T2W
- d. FLAIR
- e. proton density

80) c. \*\*\*\*

MR is a highly accurate method of local staging of rectal cancer, with better assessment of locoregional nodal involvement than CT and clear depiction of the mesorectal fascia, allowing accurate prediction of whether the circumferential resection margin will be tumour free. T2W images provide optimal visualization of the tumour, which appears as an intermediate signal-intensity mass. Contrast-enhanced T1W images result in enhancement of the normal bowel wall as well as the tumour, which may lead to upstaging. FLAIR sequences are not routinely used for rectal cancer staging.

83) What is the most common site of involvement in tuberculosis of the gastrointestinal tract?

- a. stomach
- b. duodenum
- c. ileocaecal region
- d. splenic flexure
- e. rectum

83) c. \*\*

Tuberculosis of the gastrointestinal tract may occur through ingestion of infected sputum, or by haematogenous spread to submucosal lymph nodes from a pulmonary tuberculous focus. It most commonly affects the ileocaecal region due to its abundance of lymphoid tissue and relative stasis of gut contents. Typical features at this site include circumferential thickening of the terminal ileum and caecum, a thickened ileocaecal valve and ulceration following the orientation of lymphoid follicles (longitudinal in the terminal ileum and transverse in the colon). Marked enlargement of adjacent mesenteric lymph nodes with central areas of low attenuation may be seen.



- 85) Which of the following best describes the intravenous iodinated contrast agent iodixanol (Visipaque)?
- a. ionic, high-osmolar, monomeric
  - ☒ b. non-ionic, iso-osmolar, dimeric
  - c. ionic, low-osmolar, dimeric
  - d. non-ionic, low-osmolar, monomeric
  - e. ionic, high-osmolar, dimeric

85) b. \*\*\*

Modern water-soluble, iodinated, intravenous contrast media are based on the six-carbon ring structure tri-iodobenzoic acid. Earlier contrast agents were ionic and high-osmolar, but the toxicity of these agents prompted further development. In order to decrease osmolality while maintaining an acceptable iodine concentration, the ratio between the number of iodine atoms and the number of particles in solution has been decreased either by combining two tri-iodinated benzene rings or by producing compounds that do not ionize in solution, or, more recently, by both methods. The most recent agents such as iodixanol (Visipaque) and iotrolan (Isovist) are non-ionic dimers with six iodine atoms per molecule in solution, enabling satisfactory iodine concentrations to be obtained at iso-osmolality.

- 87) A patient undergoes  $^{111}\text{In}$ -labelled white blood cell scintigraphy for investigation of suspected occult sepsis. Which of these would be regarded as abnormal on imaging at 4 hours?
- a. uptake in the large bowel
  - b. splenic uptake greater than that of the liver
  - c. uptake in the bone marrow
  - d. diffuse uptake in the lungs
  - e. uptake in the thymus in children

87) a. \*\*\*\*

Radiolabelled white cell imaging is used for detection of infection and inflammation. Images reflect the distribution of white blood cells within the body, and also localize areas of infection or inflammation. Imaging is usually performed at 18–24 hours, by which time blood pool activity is normally no longer present, and the most intense uptake is seen in the spleen, followed by the liver and then the bone marrow. Imaging is also usually performed at 2–6 hours for investigation of suspected inflammatory bowel disease, as sloughed inflamed cells may move distally and provide misleading information as to the affected site if only imaged at 24 hours. Physiological diffuse lung uptake may be seen in the first 4 hours due to cellular activation from in vitro cell manipulation, but normally decreases after this. Thymus activity may be seen normally in children. Bowel and genitourinary activity are not normally seen, and gastrointestinal activity is always abnormal. In general, focal activity outside the normal white cell distribution, which is greater than that of the spleen, suggests the presence of an abscess. Activity equal to that of the liver indicates a significant inflammatory focus. Activity less than that of the bone marrow suggests a low-level inflammatory response.

88) In the assessment of tumour response to treatment, what method of tumour measurement is used in the RECIST (Response Criteria in Solid Tumours) criteria?

- a. unidimensional (long axis dimension)
- b. unidimensional (short axis dimension)
- c. bidimensional (product of longest diameter and greatest perpendicular diameter)
- d. bidimensional (product of longest diameter and shortest diameter)
- e. volumetric



88) a. \*\*\*\*

www.recist.com

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The WHO response criteria were devised in 1981 to standardize the criteria used for measuring therapeutic response in cancer patients. These criteria set out definitions of complete response, partial response, no change and progressive disease, based upon bidimensional measurements of tumour lesions in the axial plane. The product of the longest diameter multiplied by the greatest perpendicular diameter is calculated for each measurable lesion, and the sum of these products is used to determine treatment response. The RECIST criteria were introduced in 2000, and were designed to be used in clinical trials. The criteria involve classifying the disease burden into measurable and non-measurable disease, followed by selection of up to 10 representative target lesions. The sum of the long axis dimension of the target lesions in the axial plane is used to determine the final response category. Potential concerns about the use of the RECIST criteria include possible confusion arising when lymph node measurements are performed using the short axis dimension and the increased workload involved for the radiologist.

e Measure where the target lesion is largest, even when the slice and orientation are different compared to baseline

f Measure long and short axis of lymph nodes.  
the short axis is perpendicular to long axis

f Usually short axis of lymph nodes that is been taken in account in assessing size

correct



WR

90) In normal anatomy, the portal vein is usually formed by the confluence of which vessels?

- a. left and right portal veins
- b. inferior and superior mesenteric veins
- c. superior mesenteric and splenic veins
- d. inferior mesenteric and splenic veins
- e. left, middle and right hepatic veins

90) c. \*\*

The splenic and superior mesenteric veins join to form the main portal vein slightly to the right of the midline behind the neck of the pancreas at L1–2 level. The extrahepatic portal vein is about 8 cm long, and divides into the right and left portal veins at the porta hepatis. The inferior mesenteric vein most commonly drains into the splenic vein, but may drain into the splenic/superior mesenteric vein confluence in 30% of cases or the superior mesenteric vein in 30%.

92) During double-contrast barium enema, a prone overcouch film with the tube angled 45° caudally, centred 5 cm above the posterior superior iliac spines, is performed to optimally visualize which segment of the large bowel?

- a. caecum
- b. hepatic flexure
- c. transverse colon
- d. splenic flexure
- ☒ e. sigmoid colon

92) e. \*\*

The prone-angled, overcouch view performed as described separates overlying loops of sigmoid colon.

93) For relief of malignant biliary obstruction by percutaneous stenting, which factor is an advantage of using a metallic rather than a plastic stent?

- ☒ a. higher long-term patency rates
- b. lower cost
- c. easily removed if infection develops
- d. does not shorten following deployment
- e. higher surface area

93) a. \*\*\*\*

Percutaneous or endoscopic biliary stenting is usually performed to relieve jaundice in patients with malignant biliary obstruction. Metallic or plastic stents may be used. Metallic stents have a larger internal diameter and have higher long-term patency rates than plastic stents, as well as a low surface area that reduces bacterial colonization and subsequent fibrous deposition. However, metallic stents become incorporated into the bile duct mucosa and are not easily removed, which may present particular problems if the stent becomes infected. They are also prone to shortening following deployment, and a long-segment obstruction may therefore require multiple stents. In addition, the cost of metallic stents is approximately 10 times that of plastic stents.

95) For a standard portal-phase spiral CT of the abdomen and pelvis, after what period of time following commencement of the intravenous contrast injection should image acquisition begin?

- a. 0 seconds
- b. 10–15 seconds
- c. 25–30 seconds
- d. 65–70 seconds
- e. 120–180 seconds

95) d. \*\*

For a standard, single-slice, spiral CT of the abdomen and pelvis in a single breathhold, 100–150 ml of 300 mg/ml iodine intravenous contrast medium should be administered at 3–4 ml/s. For a portal phase examination, image acquisition should begin 65–70 s after commencement of the injection.



96) What is the most common side effect associated with administration of superparamagnetic iron oxide particles as a contrast agent during MRI?

- a. urticarial skin rash
- b. back pain
- c. nephrotoxicity
- d. nausea
- e. headache

96) b. \*\*\*\*\*

The most common complication of administration of superparamagnetic iron oxide particles is acute severe back pain, which is seen in approximately 4% of patients. This is thought to be a side effect of particulate agents in general, and lasts for the duration of the infusion and slightly beyond. The risk is higher in patients with liver dysfunction, and when the infusion is administered more rapidly than over the recommended 30 minutes. Slowing of the infusion rate or termination of the infusion with recommencement after resolution of the back pain is usually sufficient to alleviate the symptoms.

100) From which vessel does the majority of the arterial supply to the pancreas derive?

- a. splenic artery
- b. left gastric artery
- c. superior pancreaticoduodenal artery
- d. right hepatic artery
- e. superior mesenteric artery

100) a. \*\*\*

The main arterial supply to the pancreas is from the splenic artery, which provides numerous small branches into the pancreatic substance as it runs along the superior pancreatic border, as well as several larger arteries including the dorsal pancreatic artery from its proximal end (which may alternatively arise from the coeliac artery) and the arteria pancreatica magna halfway along its length. The pancreatic head has a dual blood supply, from the superior pancreaticoduodenal artery (derived from the gastroduodenal artery) and the inferior pancreaticoduodenal artery (derived from the superior mesenteric artery). The transverse pancreatic artery also runs along the length of the pancreas beside the main duct, and there are multiple anastomoses between the various vessels, allowing multidirectional flow.

7. A young patient is diagnosed with multiple endocrine neoplasia (MEN) type 3 (also known as type 2b) after an episode of bowel obstruction. Which one of the following features would he be unlikely to have or develop in the future with this diagnosis?
- a. Medullary carcinoma of the thyroid
  - b. Marfanoid appearance
  - c. Mucosal neuromas of the small bowel
  - d. Facial angiofibromas
  - e. Prognathism

7. d. Facial angiofibromas

MEN type 3 is a non-inherited syndrome primarily composing medullary thyroid carcinoma, pheochromocytomas and mucosal neuromas of the gastro-intestinal tract. Other features include prognathism, marfanoid appearance and cutaneous neuromas. Facial angiofibromas are associated with MEN type 1 and occur in greater than 80% of cases.



15. A 27 year old male has recurrent admissions for intermittent low-grade small bowel obstruction of unknown cause. Which one of the following investigations would be most appropriate?
- a. Contrast-enhanced CT abdomen and pelvis
  - b. Barium meal
  - c. Small bowel enteroclysis
  - d. Serial abdominal plain films
  - e. Barium follow-through

15. c. **Small bowel enteroclysis**

Small bowel enteroclysis is the most appropriate examination. CT is sensitive for high-grade obstruction as it will readily identify the level of obstruction and can demonstrate complications such as ischaemia and perforation. Enteroclysis is the preferred investigation for recurrent low-grade obstruction as it is more likely to demonstrate the presence of a transition point (for example from non-obstructing adhesions) because the bowel is distended. The examination involves passing a nasojejunal tube just distal to the duodenojejunal flexure and distending the small bowel using either dilute barium or a double-contrast examination with high-density barium and methylcellulose.

- 3 An oral cholecystogram was requested for a patient who had suspected obstruction of the cystic duct. When reviewing the patient's history what is the most definite contraindication to the technique that should be excluded?
- a Peritonitis
  - b Serious liver disease
  - c Post-operative ileus
  - d Acute pancreatitis
  - e History of atopy

3 Answer B: Serious liver disease

Peritonitis, post-operative ileus and acute pancreatitis are relative contraindications.

- 30 An 80-year-old lady presented with an acute abdomen. She suffered from diabetes, hypercholesterolaemia and had a long smoking history. On examination she has a diffusely tender abdomen with decreased bowel sounds and her pulse was irregularly irregular. Acute mesenteric ischaemia was suspected and a CT was arranged. What feature is most likely to suggest superior mesenteric artery compromise?
- a Mesenteric and portal vein gas
  - b Small bowel pseudo-obstruction
  - c Gasless abdomen
  - d Thumbprinting of bowel wall
  - e Bowel distension to the splenic flexure

30 Answer E: Bowel distension to the splenic flexure

Bowel distension of the splenic flexure (i.e. the perfusion territory of the superior mesenteric artery) is seen in approximately 40–45% of cases. The other options are all features of ischaemia but are not specific to the superior mesenteric artery territory.

- 46 In a normal adult patient, what is the relative signal intensity of the liver, muscle and spleen on T1-weighted imaging? (Options are presented in order of decreasing signal intensity, i.e. highest signal first.)
- a Liver > muscle > spleen
  - b Liver > spleen > muscle
  - c Muscle > spleen > liver
  - d Muscle > liver > spleen
  - e Spleen > muscle > liver

46 Answer B: Liver > spleen > muscle

Signal intensity is related to ratio of red to white pulp. Under eight months of age spleen < liver on T1 and T2 due to red pulp. In children and adults on T1 liver > spleen > muscle, and on T2 spleen > liver.

- 50 Elective CT colonography was performed on an otherwise well 70-year-old gentleman to investigate a recent change in bowel habit and a history of weight loss. Fortunately, no evidence of a colorectal malignancy was identified but there was an incidental finding that the gallbladder was in an unusual position. Where is the most common position for an ectopic gallbladder to lie?
- a Beneath the left lobe of liver
  - b Intrahepatic
  - c Retrohepatic
  - d Within falciform ligament
  - e Within interlobar fissure

50 Answer A: Beneath the left lobe of liver

Most frequent locations in descending order are beneath left lobe of liver, intrahepatic, retrohepatic, within the falciform ligament, within the interlobar fissure, suprahepatic, and within the anterior abdominal wall.

- 51 A middle-aged female underwent an ultrasound for right upper quadrant pain. This showed multiple gallstones in a thin-walled gallbladder with no intrahepatic biliary duct dilatation. The common bile duct was not dilated and did not contain any gallstones. What is the likely composition of this patient's gallstones?
- a Calcium
  - b Calcium bilirubinate
  - c Cholesterol
  - d Cysteine
  - e Urate

51 Answer C: Cholesterol

Seventy per cent of gallstones are either made up completely or partly of cholesterol. Thirty per cent are black pigment stones made up of predominantly calcium bilirubinate.

- 59 A 55-year-old man was investigated for weight loss and jaundice. A contrast-enhanced CT showed dilated intrahepatic biliary ducts, a common bile duct of 12-mm and a pancreatic duct of 3-mm diameter. No causative mass was seen but an ampullary tumour was suspected. What is the most sensitive technique for local staging?
- a CT
  - b Endoscopic ultrasound
  - c ERCP
  - d MRCP
  - e Laparoscopy

59 Answer B: Endoscopic ultrasound  
Eighty-five per cent staging accuracy.

- 60 An 80-year-old man was admitted with epigastric pain. A transabdominal ultrasound revealed two large epigastric cysts which appeared simple, and a contrast-enhanced CT showed them to be intrahepatic cysts occupying the left lobe and associated with marked left lobar atrophy. There was right lobar intrahepatic duct dilatation but the common bile duct was of normal calibre. What should be the next appropriate step in his management?
- a No follow-up
  - b Repeat transabdominal ultrasound in three months
  - c Interval CT in six months
  - d MRI liver
  - e Diagnostic aspiration

60 Answer D: MRI liver

Although these may be simple cysts, they should not cause left lobar atrophy or right lobar intrahepatic duct dilatation. There must be a concern of an isodense malignancy at the porta and MRI should be the next investigation.

- 3 An 82-year-old man attended for an outpatient double-contrast barium enema to investigate alteration in bowel habit. When reviewing the patient's history what is the most definite contraindication to the technique that should be excluded?
- a Rigid endoscope rectal biopsy three days ago
  - b Type 2 diabetes mellitus
  - c Angina
  - d Open-angle glaucoma
  - e Colonic resection two years previously

3 Answer A: Rigid endoscope rectal biopsy three days ago

Absolute contraindications to double-contrast barium enema include: toxic megacolon, pseudomembranous colitis and rectal biopsy (within previous five days via rigid endoscope or within previous 24 hours via flexible endoscope). Relative contraindications include: incomplete bowel preparation, recent barium meal and patient frailty.

- 4 A patient with a history of closed angle glaucoma was due to undergo a barium meal and substitution of glucagon for hyoscine-N-butyl bromide (Buscopan®) was planned. What would be a contraindication to glucagon use?
- a Iodine allergy
  - b Myasthenia gravis
  - c Pheochromocytoma
  - d Prostatic enlargement
  - e Pyloric stenosis

4 Answer C: Pheochromocytoma

Contraindications to glucagon administration include: pheochromocytoma, insulinoma and glucagonoma. Myasthenia gravis, prostatic enlargement and pyloric stenosis are contraindications to Buscopan® administration.



- 11 A new drug is being evaluated and the results of a placebo controlled trial are published. The primary end point was all cause death and the trial reports that of 400 people studied 20 of the 200 in the treatment arm died and 40 of the 200 in the control group. What is the number needed to treat (NNT) for this drug?
- a 0.1
  - b 2
  - c 5
  - d 9
  - e 10

11 Answer B: 2

The number needed to treat (NNT) is a measure of the effectiveness of the drug and is the number of patients who need to be treated to prevent one death (or other adverse outcome). It is defined as the inverse of the absolute risk reduction. In this case the probability of death in the control group is 40/200 and in the treatment group 20/200, hence the absolute risk reduction is 20/200=0.1 and the NNT is 10. The number needed to harm (NNH) is similar and is the inverse of the attributable risk (the risk in the exposed group minus the risk in the non-exposed group).

- 24 An infant presented unwell, was found to have an intussusception and reduction was planned. What is the most suitable technique for reduction?
- a Four attempts at hydrostatic reduction
  - b Hydrostatic reduction at 120mmHg
  - c Hydrostatic reduction at 220mmHg
  - d Single attempt at pneumatic reduction for four minutes
  - e Two attempts at pneumatic reduction two minutes apart

24 Answer B: Hydrostatic reduction at 120 mmHg

A rule of threes usually applies: maximum three attempts for three minutes, allowing three minutes between attempts. The pressure should be approximately 120 mmHg. (The colonic bursting pressure is approximately 200 mmHg.)

- 2 A patient attending for an abdominal ultrasound scan was noted to have a focal abnormality within the liver, which lies high within the right lobe and abuts the right hepatic vein. Which segment is the lesion most likely to involve?
- a 4A
  - b 4B
  - c 5
  - d 6
  - e 7

2 Answer E: 7

- 12 A patient presented three weeks after a laparoscopic cholecystectomy with increasing abdominal pain and raised inflammatory markers. An ultrasound showed an ill-defined low-reflectivity mass adjacent to the inferior surface of the liver with no increased Doppler signal. What is the best investigation to establish if the mass is a biloma?
- a Triple-phase contrast-enhanced CT of the abdomen and pelvis
  - b Magnetic resonance cholangiopancreatography (MRCP)
  - c Radionuclide HIDA scan
  - d White cell labelled Tc scan
  - e Radionuclide bile salt malabsorption study

12 Answer C: Radionuclide HIDA scan

White cell labelled radionuclide scans are used for the investigation of low-grade infection when no abnormality is seen on conventional imaging. MRCP is useful for imaging the biliary tree for strictures and stones but the length of time to acquire images and lack of functional imaging makes it unsuitable to diagnose a biloma. Although a collection on CT in the correct clinical setting will usually indicate a biloma a HIDA scan will demonstrate biliary excretion of Tc labelled IDA at 30 minutes and activity in the right paracolic space/peritoneum indicates a bile leak.

**16** A patient presented three months after a gastrojejunostomy with left to right anastomosis with epigastric fullness relieved by bilious vomiting, and B12 deficiency. CT demonstrated a fluid dense mass adjacent to the head of the pancreas with a further similar mass near the tail of the pancreas. What diagnosis are these findings most suggestive of?

- a Anastomotic leak
- b Blind loop syndrome
- c Incorrect anastomosis
- d Anastomotic dehiscence
- e Gastric volvulus

**16** Answer B: Blind loop syndrome

This occurs following a Billroth II procedure when the afferent loop intermittently partially obstructs and overdistends. Typical features on a contrast examination would be preferential emptying of the stomach into the proximal loop, stasis and regurgitation.

**28** A 32-year-old female was diagnosed with Crohn's disease. She had ongoing problems with recto-anal fistulae and was keen to explore a surgical solution if appropriate. The last CT of her abdomen and pelvis was performed over 18 months ago and the inflammation is currently relatively quiescent. What is the most appropriate way of further investigating the fistulae?

- a MR fistulography
- b Contrast enema
- c Transrectal ultrasound
- d No imaging, surgical exploration only
- e Repeat contrast-enhanced CT

**28** Answer A: MR fistulography

- 29 An elderly patient with acute lower gastrointestinal bleeding underwent mesenteric angiography with the aim of identifying and treating the source of the bleeding. Which is the usual order to performing this study?
- a The superior mesenteric artery is evaluated before the inferior mesenteric artery
  - b The inferior mesenteric artery is evaluated before the superior mesenteric artery
  - c There is no recommended order; evaluation should be based on the order in which the arteries happen to be catheterised
  - d The coeliac axis is evaluated before the superior mesenteric artery
  - e The renal arteries are evaluated first, followed by the other vessels in any order

- 29 Answer B: The inferior mesenteric artery is evaluated before the superior mesenteric artery

The inferior mesenteric artery is usually evaluated first as once the patient's bladder begins to fill with contrast it may become more difficult to evaluate this area. The coeliac axis is not routinely assessed when investigating lower gastrointestinal bleeding.

1. A 63-year-old man is day 7 post operative following a Billroth II partial gastrectomy for a gastric carcinoma. The initial post-operative phase was uncomplicated, but the patient has begun complaining of increasing abdominal pain. Inflammatory markers have increased with white cell count (WCC), rising from 12 to 42, and CRP increased from 8 to 56. A CT scan carried out with oral and intravenous contrast demonstrates no evidence of contrast leakage into the peritoneum. A skiff of free air is noted in the abdomen. A fluid collection is noted in the right subhepatic space, which extends toward the peripancreatic area. What is the most likely diagnosis?
- A. Leakage from the gastroduodenal anastomosis site.
  - B. Leakage from the duodenal stump.
  - C. Post-operative pancreatitis.
  - D. Tumour recurrence.
  - E. Pseudocyst formation following post-operative pancreatitis.

**1. B.** Leakage from the duodenal stump.

There is no gastro-duodenal anastomosis in a Billroth II procedure. The amylase is not sufficiently elevated for pancreatitis in most cases and there is no described abnormality in the pancreas. It is too early for pseudocyst formation and tumour recurrence.

**11. A** lesion is noted in the liver on CT and ultrasound. It is inferior, anterior, and to the left of the right hepatic vein, but to the right of the middle hepatic vein. It is inferior of the confluence of the right and left portal veins. According to the Couinaud system, what segment of the liver is the lesion in?

- A. Segment 4b.
- B. Segment 5.
- C. Segment 6.
- D. Segment 7.
- E. Segment 8.

**11. B.** Segment 5.

For a review of the segmental anatomy of the liver, please see the reference below.

Dahnert W. *Radiology Review Manual*, 6th edn, Lippincott Williams & Wilkins, 2007. p. 684.

**13. A** patient is undergoing a barium meal. What is the best position to place the patient in to see an *en face* view of the lesser curve?

- A. Left lateral. *Fundus*
- ☒ B. Left anterior oblique (LAO). *Fundus*
- C. Supine. *Greater curve and antrum*
- D. Right anterior oblique (RAO). *Body and antrum*
- E. Right lateral. *Not routinely used*

**13. B.** LAO.

The right lateral position is not routinely used. The RAO shows the body and antrum of the stomach. Supine positioning shows the greater curve and the antrum of the stomach. Left lateral position shows the fundus of the stomach.



**14. Which one of the following is false regarding peritoneal and mesenteric structures?**

- A. The lesser sac communicates with the rest of the abdominal cavity through the foramen of Winslow.
- ~B. The left paracolic gutter communicates with the left subphrenic space.
- C. The falciform ligament connects to the left coronary ligament.
- D. Part of the duodenum is suspended in the lesser omentum.
- E. The right paracolic space communicates with the pouch of Douglas.

**14. B.** The left paracolic gutter communicates with the left subphrenic space.

There is no direct connection between these two spaces due to the phrenico-colic ligament. The rest of the statements are correct.

**19. You are left in charge of a barium meal list. Due to an acute staff shortage there is only a student radiographer with you, who wants to know about which barium to use and why. Which one of the following statements regarding barium contrast media is correct?**

- A. Simethicone is added to reduce flocculation.
- B. The weight/volume ratio of barium for barium meals is 150%.
- C. The same weight/volume ratio is used for barium meals and follow-through examinations.
- D. Uniform particle size improves mucosal coating.
- E. Gastrografin can be added to improve transit time.

**19. E.** Gastrografin can be added to improve transit time.

Simethicone is an antifoaming agent. While a uniform particle size helps reduce flocculation, a heterogeneous particle size improves mucosal coating. The barium densities used for different examinations are barium swallow 150%, barium meal 250%, barium follow-through 50%, barium small bowel enteroclysis 18%, double-contrast barium enema 125%, and single-contrast barium enema 70%.

**25. A 45-year-old female is suspected to have focal areas of fat infiltration on ultrasound of the liver. An MRI of the liver is requested for further assessment. What sequences are most useful in confirming the diagnosis of focal fat infiltration?**

- A. T1WI pre and post gadolinium.
- B. T1WI and T2WI.
- C. T1WI and fat-saturated T2WI.
- D. Dual GET1WI in phase and out of phase.
- E. MR spectroscopy.

**25. D.** Dual GET1WI in phase and out of phase.

Three basic MRI techniques are available for fat detection, which work on the basis of the difference in precessional frequency between water and fat protons. These are chemical shift imaging, frequency-selective imaging, and MR spectroscopy. Dual GET1WI is the most useful sequence in clinical practice. It is based on the phase interference effect or chemical shift imaging of the second kind. When the fat and water protons are in phase there is constructive interference and when they are out of phase there is destructive interference. By comparing the signal intensities on the in-phase and out-of-phase images, fat detection is possible.

Chemical shift imaging of the first kind, or chemical shift spatial misregistration, occurs at fat-water interfaces in the frequency-encoding direction, manifesting as alternating bands of high and low signal. It is present in all standard non-fat-saturated sequences, but it can be subtle and may be missed or mistaken for image noise. Frequency-selective imaging with selective excitation or saturation depends on the homogeneity of the magnetic field and the size of the lesion.

MR spectroscopy is too time-consuming for routine clinical use.

**28. A 65-year-old male with a pancreatic head mass and obstructive jaundice undergoes percutaneous cholangiogram and external biliary drain insertion via the right lobe of the liver. The patient returns for a biliary stent insertion. On removing the external drain there is significant arterial bleed from the puncture site. A selective coeliac axis angiogram does not reveal any abnormality, but pulsatile bleeding persists. What would you do next?**

- A. Selective left gastric angiogram.
- B. Selective superior mesenteric angiogram.
- C. Selective inferior mesenteric angiogram.
- D. Selective gastroduodenal artery angiogram.
- E. Embolise coeliac axis.

**28. B.** Selective superior mesenteric angiogram.

Variations in hepatic arterial anatomy are common. According to Michel classification, the classic hepatic arterial anatomy with the hepatic artery proper dividing into the right and left hepatic arteries is seen in only 55% of the population. A replaced right hepatic artery from the SMA is seen in 11% and an accessory right hepatic artery from the SMA is seen in 7% of the population. A selective SMA angiogram should therefore be performed in this case.

A selective left gastric angiogram is not required as it is a branch of the coeliac axis. The inferior mesenteric artery does not supply the liver.

The coeliac axis divides into the common hepatic, left gastric, and splenic arteries. Embolization of the coeliac axis is therefore not an option.

**37. A** 50-year-old male undergoes MRI of the liver for further characterization of a suspected haemangioma on ultrasound. In addition to the haemangioma, a peripheral wedge-shaped area of enhancement is seen in the arterial phase but no abnormality is seen in the corresponding area in the non-contrast or portal venous phases. What is the diagnosis?

- A. Hepatocellular carcinoma.
- B. Hepatic infarct.
- ✓ C. Transient hepatic intensity difference (THID).
- D. Hypervascular metastasis.
- E. Haemangioma.

**37. C.** Transient hepatic intensity difference (THID).

THID on MRI or transient hepatic attenuation difference (THAD) on CT is a pseudolesion caused by focal alteration in the haemodynamics of the liver due to either non-tumourous arterio-portal shunt or obstruction of distal portal venous flow. THID or THAD is seen as a focal area of enhancement in the arterial phase only, with no abnormality seen in the portal venous phase. Features suggestive of THID or THAD include peripheral location, wedge shape, straight margins, and normal vessels coursing through the area.



43. A 73-year-old woman is referred from surgical outpatients for a barium enema. She has a 3-month history of weight loss and a microcytic anaemia. The procedure is unremarkable, and you leave the screening room to go and continue some plain film reporting. Ten minutes later you are contacted by one of the radiographers who was helping during the enema. She is distressed and tells you that she found the patient collapsed in the bathroom having what appeared to be a seizure. You immediately attend and assess the patient. She is drowsy, but heart rate, blood pressure, and  $\text{SaO}_2$  are normal. What is the most likely complication to have caused her acute illness?

- A. Cardiac arrhythmia secondary to rectal distension.
- B. Venous intravasation.
- C. Water intoxication.
- D. Intramural barium.
- E. Side-effect of hyoscine butyl bromide (Buscopan®).

43. C. Water intoxication.

All five options are complications of barium enema. Additional potential complications include bowel perforation, barium impaction, and transient bacteraemia. Complications during barium enema are rare. Perforation of the bowel is the most frequent serious complication, occurring in approximately 0.02–0.04% of patients. Venous intravasation may result in a barium pulmonary embolus, which carries an 80% mortality. Water intoxication causes drowsiness and convulsions, as in this case. There is an increased risk in megacolon because of the large area of bowel mucosa available for the absorption of water. Water intoxication has also been attributed to the preparatory laxatives used. Buscopan® may cause cardiac arrhythmia and should be used with caution in those with cardiac disease; other relative contraindications include angle-closure glaucoma, myasthenia gravis, paralytic ileus, pyloric stenosis, and prostatic enlargement.

**54. A 55-year-old man with a previous history of liver transplantation presents with a 1-week history of abdominal pain and distension. An AXR shows some distended small bowel loops centrally within the abdomen. You are asked to perform a CT scan of abdomen for further evaluation. This shows a cluster of non-encapsulated dilated small bowel loops adjacent to the anterior abdominal wall on the right side. There are adjacent crowded mesenteric vessels. What is the most likely diagnosis?**

- A. Small bowel adhesions.
- B. Left paraduodenal hernia.
- C. Right paraduodenal hernia.
- D. Foramen of Winslow hernia.
- ✓ E. Transmesenteric hernia.

**54. E. Transmesenteric hernia.**

This is when small bowel herniates through a defect in the mesentery and is compressed against the abdominal wall, with little overlying omental fat at most levels of anatomic section through the herniated bowel. There will be some degree of compression, crowding, displacement, and obstruction of both the bowel and blood vessels. They are usually seen in association with previous abdominal surgery and the creation of a Roux-en-Y anastomosis, when the hernia occurs in a surgically created defect in the mesentery.

A left-sided paraduodenal hernia is via the paraduodenal (lateral to the fourth part) mesenteric fossa of Landzert, close to the ligament of Treitz. The characteristic features include a sac-like mass of dilated bowel lateral to the ligament of Treitz, which displaces and indents the adjacent stomach and transverse colon.

A right paraduodenal hernia occurs via the jejunal mesentericoparietal fossa of Waldeyer. A cluster of dilated small bowel loops is seen lateral and inferior to the descending duodenum.

**60. With regard to the use of glucagon in barium enema examinations, which of the following statements is correct?**

- A. 0.1mg of glucagon is an appropriate dose.
- B. Diabetes is a contraindication to the use of glucagon.
- ✓ C. Insulinoma is a contraindication to the use of glucagon.
- D. Glucagon can be safely used in patients with phaeochromocytoma.
- E. Smooth muscle relaxation is optimal at 5 minutes and lasts approximately 1 hour.



**60. C.** Insulinoma is a contraindication to the use of glucagon.

Glucagon is a potent hypotonic agent. If 1mg of glucagon is injected intravenously it takes approximately 1 minute to work and lasts about 10–20 minutes. Intravenously administered glucagon decreases discomfort during barium enema examinations. Glucagon administration is generally safe, but is contraindicated in patients with insulinoma and phaeochromocytoma. Diabetes is not a recognized contraindication.

**69. A 75-year-old man is undergoing a CT colonography examination for investigation of a change in bowel habit. He has difficulty retaining the CO<sub>2</sub> for adequate bowel distension. Which of the following segments of colon is likely to be better distended on the prone scan?**

- A. Caecum.
- B. Transverse colon.
- ☒ C. Rectosigmoid.
- D. Ascending colon.
- E. Hepatic flexure.



**69. C.** Rectosigmoid.

On a prone scan during a CT colonography examination, the rectosigmoid is generally better distended than on the supine scan because it is a more posteriorly placed structure and air gets displaced to the non-dependent position. The other segments named are usually better distended on the supine scan, particularly the caecum and transverse colon, as these are more anteriorly placed within the abdomen.

**2 A patient with proven Hodgkin lymphoma is referred for a staging PET-CT. This shows a solitary focal lung lesion with cervical and mediastinal lymph node enlargement. All of these lesions are PET positive with no other sites of disease.**

**What stage is this disease?**

- (a) I
- (b) II
- (c) IIE
- (d) III
- (e) IV

**2 (c)**

This describes stage IIE: localised involvement of a single extralymphatic organ or site and its regional lymph nodes with or without involvement of other lymph node regions on the same side of the diaphragm. Disseminated or multifocal extralymphatic disease would constitute stage IV disease.

**5 A 47 year old man undergoes a CT and subsequently an MRI. These show an area of focal fat accumulation adjacent to the falciform ligament anteriorly.**

**This may be attributed to flow within which of the following?**

- (a) Vein of Sappey
- (b) Cholecystic vein
- (c) Right gastric vein
- (d) Anterior gastric vein
- (e) Inferior epigastric vein

**5 (a)**

This is a common aberrant vein which drains the superior epigastric vein and/ or the internal thoracic veins and communicates with the left portal vein branches.

**9 With regard to radiation enteropathy, which of the following is not true?**

- (a) Acute changes occur in patients who have received 1,000cGy or more
- (b) Acute changes are due to damage to the blood supply
- (c) Chronic changes may be seen in up to 15% of patients
- (d) Multiple stenoses are a feature of chronic disease
- (e) Acute radiation enteropathy refers to changes within the first 2 months

**9 (b)**

Acute radiation enteropathy is due to death of the mucosal cells which are dividing rapidly. Chronic enteropathy is due to the effect on the vasculature, resulting in strictures, adhesions and fistulae.

**12 A patient with multiple medical problems is referred for CT colonography and requires intravenous hyoscine butylbromide (Buscopan) as part of the procedure.**

**Which of the medical conditions listed are contraindications to this?**

- (a) Open angle glaucoma
- (b) Hypertension
- (c) Ischaemic heart disease
- (d) Myasthenia Gravis
- (e) Parkinson's disease

**12 (d)**

In addition, Buscopan is contraindicated in patients with megacolon, untreated narrow angle glaucoma, tachycardia, hypertrophy of the prostate with urinary retention, and mechanical stenoses of the gastrointestinal tract.

**14 A patient with a metastasis from a GIST tumour undergoes a contrast-enhanced CT study before and after chemotherapy. On the initial study, the lesion measures 5 cm in diameter and has a density of 100 HU. At follow up, the lesion measures 6 cm and has a density of 80 HU.**

**How should you classify the response to chemotherapy?**

- (a) Complete response
- (b) Partial response
- (c) Mixed response
- (d) Stable disease
- (e) Progressive disease

**14 (b)**

Metastatic GIST tumours are treated with monoclonal antibody agents. These typically reduce the blood supply and metabolism of the tumours with little change in tumour size and as such, the RECIST criteria are of little value. The Choi criteria differ from RECIST in that to obtain a PR, one needs a 10% reduction in size or a 15% reduction in density. Progressive disease requires 10% tumour growth without a 15% reduction in lesion density, a new lesion or a new or growing nodule of enhancing tumour within an existing lesion. There is no mixed response category.

**15 Regarding 2nd generation US contrast agents, which of the following statements is true?**

- (a) Hepatocyte-specific agents are of particular value in characterising liver lesions
- (b) Microbubbles persist for 30 minutes
- (c) Excretion is mainly through biliary pathways
- (d) A high mechanical index setting is required for dynamic imaging
- (e) Metastases are best seen in the delayed phase (2-5 min)

**15 (e)**

US contrast agents are microbubbles comprising a 'shell' containing an inert gas, which is injected *i.v.* and may persist for up to 6 hours. The agents stay within the blood pool, but for an unknown reason pool in the sinusoids during the delayed (2–5 min) phase, hence metastases are well depicted. Imaging is performed using a low mechanical index (0.1–0.2) to avoid bursting the bubbles.

- 18 A patient is referred for a CT of the chest, abdomen and pelvis, the clinical details read "Riedel's thyroiditis. Hyper-IgG4 disease". Are any other organs involved?**

**Which of the following conditions are not associated?**

- (a) Cryptogenic organising pneumonia
- (b) Benign pleural mesothelioma
- (c) Systemic sclerosis
- (d) Autoimmune pancreatitis
- (e) Retroperitoneal fibrosis

**18 (c)**

Hyper IgG4 is a chronic inflammatory condition that may involve a number of organs. It is characterised histologically by a lymphoplasmacytic inflammation with IgG4-positive cells and exuberant fibrosis, which leaves dense fibrosis on resolution. It may respond to corticosteroids or other immunosuppressant therapy. Sclerosing sialadenitis, retro-orbital pseudotumour, and panniculitis may also be seen.

- 30 A patient with a pyrexia of unknown origin is referred for a radio-labelled white cell scan with Tc-99m HMPAO.**

**At which time points should imaging of the abdomen be performed?**

- (a) 1 and 3 hours
- (b) 1, 3 and 6 hours
- (c) 1 and 6 hours
- (d) 1, 3 and 24 hours
- (e) 1, 6 and 24 hours

**30 (a)**

<sup>99m</sup>Tc-HMPAO begins to break down by 4 hours as it is not as stable as <sup>111</sup>In; thereafter, breakdown products may be seen within the bile and intestines.



- 31 A patient is referred for the investigation of right upper quadrant pain. US has equivocal findings and a HIDA examination is requested. At 35 minutes, there is little uptake within the liver, but renal excretion is noted.**

**What is the most likely cause for these findings?**

- (a) Poor liver function
- (b) Acute cholecystitis
- (c) Poor renal function
- (d) Sphincter of Oddi dysfunction
- (e) Chronic cholecystitis

**31 (a)**

Liver uptake should be seen within 10 minutes. Thereafter, there is filling of the gallbladder and subsequent excretion to the bowel. Cholecystitis impairs uptake to the GB.

- 33 A patient with Hodgkin's lymphoma undergoes a PET-CT which shows a 10 x 5 cm nodal mass which is PET positive. Following 2 cycles of chemotherapy, the nodal mass measures 6 x 3 cm but there is no uptake of FDG within the mass.**

**How should you report this study?**

- (a) Partial response
- (b) Stable disease
- (c) Mixed response
- (d) Too early to assess response
- (e) Complete response

**33 (e)**

If a PET positive lesion becomes PET negative, this is regarded as a CR irrespective of the size of the nodal mass. Early assessment (after 1 or 2 cycles of chemotherapy) appears to be a better predictor of long term outcome than later imaging.

- 37 A patient is referred for an abdominal radiograph and telephones the department to ask about radiation.**

**What is the typical effective dose of a plain abdominal radiograph?**

- (a) 0.02 mSv
- (b) 0.3 mSv
- ✓ (c) 0.7 mSv
- (d) 1 mSv
- (e) 1.5 mSv

**37 (c)**

A chest radiograph has an effective dose of approximately 0.02mSv or 3 days background radiation. An abdominal film has a dose 35x that at 0.7mSv, equivalent to 4 months background radiation.

- 41 Which of the following statements regarding the internal anal sphincter is true?**

- (a) It is made of striated muscle
- (b) Isolated injury is usually due to obstetric injury
- (c) It appears hyperechoic on endo-anal ultrasound
- ✓ (d) It is the termination of the circular smooth muscle of the gastrointestinal tract
- (e) ~~The deep part fuses with the puborectalis sling and levator muscles~~

**41 (d)**

The IAS comprises smooth muscle and is not under voluntary control. It appears hypoechoic on US. Obstetric injuries involve the external anal sphincter +/- IAS. Isolated injury is due to endo-anal trauma e.g. haemorrhoid surgery. Answers (a) and (e) pertain to the external anal sphincter, which is under voluntary control.

- 43 A 56 year old HIV-positive man presents with diarrhoea which the clinical team feel is due to a gastrointestinal infection. His CD4 count is 350.

Which of the following is most likely?

- (a) Mycobacterium tuberculosis *seen when CD4 < 400*  
(b) Herpes simplex virus  
(c) Candida albicans *when CD4 < 100*  
(d) Cytomegalovirus  
(e) Cryptosporidium

43 (a)

Extrapulmonary TB is seen as the CD4 count falls below 400. Candida and Cryptosporidium are associated with a CD4 <200; HSV and CMV are associated with a CD4 <100.

- 5 You are asked to review a follow-up CT for a patient with a metastatic melanoma in a clinical trial. There is a single deposit within the liver which measured 10 cm on the initial study and now measures 6 cm.

How should you classify the response by RECIST criteria?

- (a) Complete Response  
(b) Complete Response Unconfirmed  
(c) Partial Response  
(d) Stable Disease  
(e) Progressive Disease

5 (c)

A reduction of >30%, falling short of a complete response, constitutes a partial response.

**12 Which of the following is not considered to be a risk factor for the development of cholangiocarcinoma?**

- (a) Tobacco smoking
- (b) Heavy alcohol consumption
- (c) Hepatitis C virus
- (d) Polyvinyl chloride exposure
- (e) Caroli disease

**12 (a)**

Tobacco smoking is not associated with cholangiocarcinoma, but there are a large number of other associations, including viral agents (HIV, HBV, EBV), liver flukes, hepatolithiasis, primary sclerosing cholangitis and biliary anomalies.

**16 A 47-year old man presents with atypical RIF pain; a CT abdomen is requested to rule out appendicitis. No cause for abdominal pain is identified. The only finding of note is an 8 mm low-attenuation lesion within the left lobe of the liver. The lesion lies inferior to the portal vein and lateral to the left hepatic vein.**

**What segment of the liver is the lesion in?**

- (a) Segment I
- (b) Segment II
- (c) Segment III
- (d) Segment IV-A
- (e) Segment IV-B

**16 (c)**

The Couinaud classification divides the liver into 8 functionally independent segments, each with its own blood supply and biliary drainage. The portal vein divides the liver into superior and inferior segments. The middle hepatic vein divides the left (segments I-IV) and right lobes (segments V-VIII). The right hepatic vein divides the right lobe into anterior (V and VIII) and posterior (VI and VII) segments. The left hepatic vein divides the left lobe into medial (segments IV-A and IV-B) and lateral part (segments II and III); segment I is the caudate lobe, situated posteriorly.

**21 A patient with a primary oesophageal tumour undergoes a PET-CT study using  $^{18}\text{F}$ FDG before and after receiving 1 course of chemotherapy.**

**In order to achieve a partial response, by how much does the standardised uptake value (SUV) need to fall between these 2 studies?**

- (a) 10%
- (b) 15%
- (c) 20%
- (d) 25%
- (e) 50%

**21 (b)**

The EORTC define a partial response as a 15% reduction at 1 cycle or 25% reduction at 2 or more cycles. Progressive disease is a 15% increase after 1 cycle or 25% after 2 or more cycles.



**23 In the assessment of small bowel disease, for which of the following criteria is MRI superior to other imaging modalities?**

- (a) Shorter imaging time
- (b) Better depiction of early disease
- (c) Superior spatial resolution
- (d) Better mucosal detail
- (e) Superior tissue contrast

**23 (e)**

Small bowel enema has the best resolution and better depicts early disease. CT is the fastest study to perform. MRI has superior tissue contrast.

**28 Which of the following techniques is not used to reduce patient dose during abdominal CT?**

- (a) Dual energy CT
- (b) Reduced mAs
- (c) Increased kV
- (d) Iterative reconstruction
- (e) Automatic exposure control

**28 (c)**

Increasing the kV will increase patient dose. Automatic exposure control modulates the mAs delivered in real time and reduces the dose to the patient. Dual energy CT alternates two energy sources and has the result of reducing dose.

- 30 You are asked to supervise a CT enterography study for inflammatory bowel disease which has been protocolled for a single 'enteric phase'.**

**Approximately how long after the commencement of the *i.v.* injection of contrast medium should the study be acquired?**

- (a) 20 secs
  - (b) 45 secs
  - (c) 70 secs
  - (d) 100 secs
  - (e) 180 secs
- 

**30 (b)**

This optimises mural enhancement. By contrast, in the evaluation of small bowel neoplasia or obscure GI bleeding, an unenhanced, arterial and portal venous study are usually used. Neutral oral contrast agents are usually favoured, although positive agents may have a role when intravenous contrast medium is contraindicated.

- 44 What volume of haemorrhage, approximately, would be required to give a positive result on at scintigraphy with radio-labelled red blood cells?**

- (a) 5 ml
- (b) 25 ml
- (c) 50 ml
- (d) 100 ml
- (e) 200 ml

**44 (c)**

Approximately 50 ml, which is similar to the volume required to give malaena. Nuclear medicine techniques are unlikely to be of value when GI bleeding is only detected by chemical tests, e.g. faecal occult blood.

- 45** A patient with multiple medical conditions is referred for the further investigation of a neuroendocrine tumour with  $^{123}\text{I}$ -mIBG.

**Which of the following drug classes do not affect mIBG uptake?**

- (a) Opioids
- (b) Tricyclic antidepressants
- (c) Calcium channel blockers
- (d) Non-steroidal anti-inflammatory drugs
- (e) Angiotensin converting enzyme inhibitors

**45 (d)**

Tramadol, antipsychotics, phenothiazines, butyrophenones, salbutamol, amiodarone and cocaine may also interfere with MIBG uptake.

- 55** Which of the following conditions is not associated with *Helicobacter pylori* colonisation?

- (a) Oesophageal cancer
- (b) Gastric ulcer
- (c) Gastric carcinoma
- (d) MALT lymphoma
- (e) Duodenal ulcer

**55 (a)**

Oesophageal carcinoma rates have been increasing as *H. pylori* colonisation rates have fallen. A protective effect against some conditions has been postulated but this is highly controversial.

**57 According to the RCR's 'Making the best use of clinical radiology services', for which of the following indications is an abdominal radiograph given the recommendation 'Indicated'?**

- (a) Acute GI bleeding
- (b) Ingested coin
- (c) Chronic pancreatitis
- (d) Palpable mass
- (e) Constipation

**57 (c)**

The AXR may show calcification, but is of little value in excluding this diagnosis. Ingested foreign bodies should only have abdominal radiographs if they may be dangerous e.g. battery. Constipation is only an indication in specific circumstances.

**62 A pregnant lady presents with severe right iliac fossa pain. The surgical team request an MRI to evaluate the appendix.**

**What imaging sequence is best for depicting the appendix?**

- (a) T1
- (b) T2
- (c) STIR
- (d) FLAIR
- (e) DWI

**62 (b)**

T2 weighted images best depict the appendix, but a STIR sequence is sensitive for identifying an inflamed and oedematous appendix. MRI has a sensitivity, specificity and accuracy of over 90% for the diagnosis of acute appendicitis.

**66 Following solid organ transplantation, post-transplantation lymphoproliferative disorder most commonly affects which of the following organs?**

- (a) Lungs
  - (b) Liver
  - (c) Spleen
  - (d) Kidneys
  - (e) Bowel
- 

**66 (b)**

The liver is affected most frequently, with involvement seen in up to 45% of liver transplant PTLDs, 40% of pancreas transplant PTLDs, 23% of heart transplant PTLDs and 10% of lung transplant PTLDs.

**70 In abdominal imaging with 3T MRI, parallel imaging is commonly used to reduce aliasing and susceptibility artefacts.**

**Which of the following is not a feature of parallel imaging?**

- (a) Increased signal-to-noise ratio
  - (b) Reduced acquisition time
  - (c) Increased homogeneity of signal across the field of view
  - (d) Improved contrast on T1-weighted images
  - (e) Reduced T2 blurring
- 

**70 (a)**

Parallel imaging has a number of advantages, but reduces the signal-to-noise ratio. Abdominal imaging at 3.0T brings a number of challenges which are more difficult to overcome than in neurological or musculoskeletal imaging.